(Established 1832.)

AMERICAN ENGINEER AND RAILROAD JOURNAL.

RAILWAY SHOPS.

BY R. H. SOULE.

II.

GENERAL CONSIDERATIONS.

Before taking up the different departments in detail it would be well to consider those more general questions which, in a problem of shop design, always precede the actual mapping out of the several buildings. The location is the first of these, and it naturally becomes fixed at what might be called, in a transportation sense, the center of gravity of the district or system to be served. This is always a terminal or division point, and often a junction point as well. This consideration usually outweighs the question of labor and material supply, which otherwise would be the determining factor. It seldom has happened that shops were designed first, and a corresponding plot of land purchased subsequently; on the contrary, railway companies have usually anticipated the actual planning of new shops by acquiring available property adjacent to their right of way and otherwise favorably located. This has sometimes resulted in extremes, such as a nearly square tract of land, or, on the contrary, a long, narrow strip. The former condition is found at the Burnside (Ill.) plant of the Illinois Central Railroad, and the latter exists at the Horwich shops of the Lancashire & Yorkshire Railway of England. Either condition is a restraint on the free grouping of buildings and arrangement of track approaches; at both places very clever solutions have been found, however. The ratio of length to breadth in a plot of ground thus reserved for shop purposes should preferably fall between these extreme limits. The acreage should be liberally ample, and when the exact layout plan has been decided on, and space reserved for all possible extension, the surplus land, if any, may be disposed of. In such a case, restrictions may be placed on the property sold, and the character of the neighborhood thus guaranteed, to a certain extent. Access to a group of shop buildings by other means than railway tracks being desirable, a public road (if one does not already exist) should be laid out along one edge of the property. Gifts of land for shop purposes, or contributions towards its cost, should not be too hastily accepted; title to such lands may come into question later on, if the railroad company modifies its manner of using the same. Two such cases, within the knowledge of the writer, have occurred on American railways within the last ten years.

The shop site having been chosen and the land provided, the character and quantity of work to be done in the completed plant must be determined or assumed. This will usually crystallize out into a certain number of locomotives and cars, passenger and freight, to be maintained, or built, or both, per unit of time, usually per month. It is safer to proportion the shops on the basis of the greatest output likely to be required during any one month of the year, than it is to work on the basis of assuming the monthly output to be simply one-twelfth of the desired yearly output. The trend of organization, resulting from the general experience of railways, being towards merging the locomotive and car departments under one control, the typical railway central repair plant will comprise all of the several shops which are required in either connection. Separate locomotive and car repair plants may, of course, be justified where work of each kind is prosecuted on a large scale, or on account of special or local considerations. In the more general case of the combined shop, however, certain of the departments can be used jointly for both locomotive and car work; such, for instance, are the storehouse, the machine shop, the smith shop, the foundry, the carpenter shop, and the paint shop. This list of joint shops emphasizes the fact that great economy can, in general, be accomplished by the concentration of the work of locomotive and car repairs into one group of buildings, as otherwise at least five of these six subdepartments (the foundry being possibly excepted) would have to be duplicated. When there is but one such group of buildings, yard service, whether by switching engine or laboring gang, can also be economized.

One-story buildings are always to be preferred if concentration does not have to be sacrificed. Day lighting and internal transportation are both easier to accomplish in one-story structures. The only exception to the general principle is in the case of those few departments where the work is light, such as the tin shop and the upholstery shop. The office and storehouse buildings may be, and generally are, of two-story construction, however. In this connection it must be acknowledged that artificial lighting, under present conditions, is so cheap and satisfactory that the shutting off of daylight does not reduce output as much as in the old days of oil lamps and torches.

Having determined the number of departments to be provided for, and the amount of work to be done, each must be considered separately and the essential dimensions fixed upon; but the grouping and relative arrangement of departments must be constantly borne in mind. Labor saving devices are of first importance as features to be incorporated in the original design of a building; next in importance is the providing of such facilities of every sort as will guarantee that the labor which cannot be saved but must be expended shall be used and applied under conditions of maximum efficiency and economy. The logic by which improvement investments are justified is simply a satisfactory demonstration that interest depreciation and repairs will totalize less than the wages of unassisted labor would have amounted to in accomplishing the same result. A very satisfactory rule which is in use on one of our western lines is that any proposed improvement which will save labor amounting to 10 per cent. of its cost will be favorably considered. The credit of this company being on a 3 per cent. basis, it is argued that such a transaction is virtually a 7 per cent. investment.

Each building having thus been worked out as a problem by itself, the grouping and layout can be considered. The evolution of recent years has tended towards bringing together under one roof such departments as are mutually dependent on one another, and have a continuous interchange of materials. The smith shop and the foundry are generally isolated on account of the smoke and dust which results from their operation. Buildings which must be separated, but which house departments which are dependent upon one another, should be kept as close together as possible. Modern practice tends toward restricting such inter-shop space to from 40 to 60 ft. While due regard must be given to the question of fire risk, it must not be allowed to exclusively dominate the situation, as in a recent case on an eastern trunk line where an insurance company which had issued a blanket policy notified the railroad company that a proposed new erecting shop must not be within 100 ft. of any adjacent building.

A prime requisite in planning railway shops is that the preliminary work shall be done by some one who has become familiar, by actual experience, with the operation of such

shops. The architect has no legitimate place in this preliminary work, and his services, if needed at all, may be availed of when structural details and embellishments require attention. But the mechanical engineer and the civil engineer can cope with the bulk of the problems involved.

AMERICAN ENGINEER TESTS.

Locomotive Draft Appliances.

REPORT BY PROFESSOR W. F. M. GOSS.

SECTION VI.

DISCUSSION OF RESULTS.

(Continued from page 76.)

35.—A Basis of Comparison.—In outlining the tests, it was proposed to base all comparisons upon the efficiency of the jet, and efficiency was defined as the ratio of back pressure to draft (See paragraph 5). The assumption of such a measure is based upon the fact that the result which is sought by the use of any combination of draft appliances is a reduction of pressure within the front-end, and that the force effecting such a reduction of pressure is a function of the pressure of steam in the passage between the cylinders and the exhaust tip. The maintenance of considerable pressures in the exhaust passages tends to reduce the economic performance of the engine, hence it is desired that the necessity for such pressures be, so far as practicable, avoided. The proposed measure of efficiency takes all this into account, for by its use that arrangement of apparatus which will give a desired reduction of pressure in the front-end in return for the least back-pressure will be the most efficient. Such a conception is perfectly logical. It is not new, but on the contrary is one which has been many times employed in the study of draft appliances.

The preceding statement is general in its application. It applies not only to the tests under consideration but to all tests which may be made for the purpose of determining the value of this or that draft appliance. It happens, however, that in the experiments under consideration, the exhaust tip was of the same size for all tests. Furthermore, it appears as one of the significant results obtained from the tests that a change in the height of the exhaust-pipe does not affect the back-pressure by a measurable amount. Consequently, so far as the present study is concerned, the back-pressure for any given condition of running appears as a constant; and the efficiency which, in the general case, is a function of both back-pressure and draft, is left to depend upon draft alone. In other words, the changes which were made in the stack and exhaust-pipe arrangement, in the process of carrying out the series of experiments under consideration, were not such as affected the back-pressure. A change in the diameter of the exhaust tip would have done this, but through the present work a fixed diameter of tip was employed. All this being true, it appears that effects resulting from changes in the front-end mechanism, such as were involved by the experiments under consideration, are quite as well shown by a direct comparison of draft values as by a comparison of efficiency values. Moreover, the draft values involve a single observation made under conditions favorable to accuracy, and consequently they supply a better basis for comparison than efficiency, which depends on two observations, one of which is rather difficult to obtain with accuracy. In view of these considerations, it has seemed wise to depart from the original outline which requires that comparisons be based on efficiency, and adopt a new plan by virtue of which comparisons shall be based on draft alone. It will be noted that in all the work which follows, this has been done, though in the tabulated statement of data, for the convenience of those who may wish to compare the results herewith presented with those obtained by other experimenters, values for efficiencies are presented for each test.

Thus far, however, justification for basing comparisons on draft rather than upon the ratio of back-pressure to draft, rests entirely upon assertions concerning the existence of a definite relation between draft and back-pressure, the truth of which it will now be well to consider.

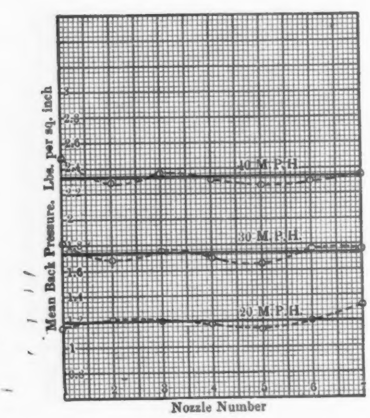


FIG. 30.

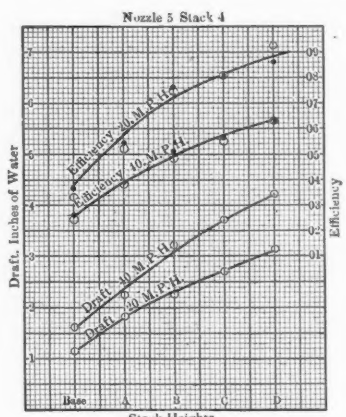


FIG. 31.

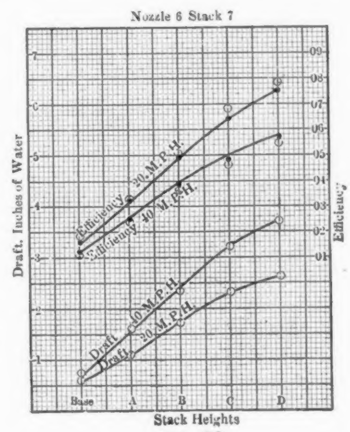


FIG. 32.

36.—Relation Between Draft and Back-Pressure as Disclosed by Tests.—It was to have been expected that changes in the stack would have little or no effect upon the back-pressure, but it has not before been shown that an increase of 30 ins. in the length of the exhaust pipe would produce no measurable change in back-pressure. A direct comparison of back-pressures as obtained from different lengths of exhaust pipes under similar conditions of running, is presented as Fig. 30. In these diagrams, the nozzle heights are plotted along the horizontal axis, the verticals representing back-pressure. Observed back-pressures are denoted by circles, and the mean values of the back-pressure obtained by averaging all of the observed values taken during the tests, with each of the seven heights of nozzle, are represented by full lines. The result of such a comparison shows that none of the average values vary from the mean of all values by more than 6 per cent, and, considering the difficulty experienced in obtaining reliable readings of the back-pressure gauges, it is entirely justifiable to assume that the straight lines drawn as indicated in the figure referred to fairly represent the true back pressure.

The usual formula for efficiency, as already defined, is

$$E = \frac{D}{p} = \frac{1}{p} D$$

in which E is the efficiency, D the draft, and p the back-pressure. But it has just been shown that for any given cut-off and speed, the tests under consideration show the back-pressure p, to be constant. Hence $\frac{1}{p}$ is a constant, and E in the equation is directly proportional to D, which is mathematical proof that comparisons based on draft will have the same significance as those based on efficiency.

For the benefit of those to whom the preceding demonstration does not appeal, the fact may be made to appear more simple when shown graphically as Fig. 31. In this figure, the draft curves obtained with a given nozzle (No. 5) and the several heights of stack at speeds of twenty and forty miles per hour, are plotted and drawn as full lines. Above these draft curves are values representing efficiency calculated in the ordinary manner from observed data with results represented by solid dots. These are to be compared with corresponding points obtained by multiplying draft values by a constant, based on the average back-pressure, with results indicated by circles on or near the efficiency curves. A very close agreement between the two sets of points is thus disclosed. A similar presentation involving data from another height of nozzle (No. 6) and another stack (No. 7) is presented as Fig. 32, and any of the experimental data similarly plotted will give substantially the same results. It is evident from an inspection of the diagrams (Figs. 31 and 32) that the efficiency curves and draft curves are substantially identical in form, and hence values represented by one are proportional to corresponding values represented by the other. As a means by which to compare results of tests, therefore, either may be used with equal advantage, and for reasons which have already been stated, use will be made of the draft in the discussion which is to follow.

37.—A Study of Results by Means of Plotted Curves.—Having presented the data obtained from the tests of stacks, it had been the intention of the undersigned to proceed at once with a presentation of conclusions derived therefrom. It has been suggested, however, by certain gentlemen who have assisted in the advancement of the work that there should be some diagrammatic presentation of the results. It has been urged that such a presentation would permit the effect of the various changes to be at once seen and would give at a glance a measure of relative values. In compliance with this suggestion, and with the assent of the AMERICAN ENGINEER, such an exhibit is herewith presented. (Figs. 33 to 88.)

With reference to this exhibit, the following should be noted. First, that all curves are plotted in terms of draft as measured in inches of water and stack diameters. As four different heights of stacks were employed, there are four series of curves for each height of nozzle, and as seven heights of nozzles were employed, there are twenty-eight diagrams for each form of stack. Each group of four figures represents all diameters of stacks for a given nozzle. Figures, therefore, from 33 to 60, inclusive, represent straight stacks and Figs. 61 to 88, inclusive, represent taper stacks.

(To be continued.)

The New York Central & Hudson River Railroad has found it necessary to provide a special organization to conduct its extensive electrical application in and near New York City. This work will be in charge of a commission consisting of Mr. W. J. Wilgus, fifth vice-president; Messrs. B. J. Arnold, F. J. Sprague, George Gibbs, and A. M. Waitt. Mr. E. B. Katte, electrical engineer, will have charge of the electrical and mechanical work and will report to the commission. Mr. Katte is succeeded as mechanical engineer of the chief engineer's department of the road by Mr. A. J. Slade, who will have charge of the work in connection with heating, lighting, power plants, and fuel and water supply stations.

THE INFLUENCE OF TIME ELEMENT ON MECHANICAL AND TRANSPORTATION MATTERS.

BY H. T. HERR,

MASTER MECHANIC, NORFOLK & WESTERN RAILWAY.

A great deal has been written on the subject of "Ton Mile Statistics" and voluminous data have been and are now prepared on this subject for the information of officers and employees of railways and for current reports for the general public.

Until within a comparatively short time, records of performance were generally based on engine mileage in relation to mechanical matters and train mileage in relation to transportation matters. The use of the ton mile for statistics may be said to be of recent origin, or at least its adaptation to general statistics has existed for a comparatively short time. That ton mileage is of more value in studying operating statistics than either the engine mile or train mile, in recognizing efficient operation, in giving a fairer comparison and a truer measure of what the road has done, will not, I think, be questioned.

Analyzing a few current terms familiar to most railway men and determining a unit of measure for general comparison, which shall combine the various elements entering strictly into the movements which occur on railroads in general, leads to the following discussion.

We require for our major premises these considerations:

First—Assume the railway established and that maintenance of the permanent way shall not be considered.

Second—Traffic cannot be moved without the expenditure of power.

Third—Power involves three elements, viz., force, distance and time.

Fourth—Work involves two elements, viz., force and distance.

Fifth—The commodity in which a railway deals is the moving of traffic.

Sixth—The cost of fuel and wages of train and engine men constitutes a majority of the expenses of moving traffic, supervision of conducting transportation representing but a small percentage.

Seventh—Cost of fuel and wages of train and engine men is variable, dependent on the traffic moved and the time.

Eighth—Cost of supervision is practically constant, between wide limits, i. e., independent of traffic moved.

Ninth—Independent of the maintenance of equipment, which should vary almost directly as the traffic moved and the time, efficient operation will obtain when the greatest traffic is moved with the least expenditure for fuel and wages of train and engine men with a proper relation to the time of movement of the traffic.

In considering the probable capacity of a railway as a common carrier two things are of vital importance, viz., the motive power and equipment. Recent conditions on many roads have indicated that the traffic was far beyond the capacity of facilities of power and equipment to move it, and it has not been uncommon for railway officers in general to hear the terms "Shortage of power" and "Shortage of equipment." Engines have frequently been loaded beyond capacity in the attempt to move freight when equipment was obtainable, with consequent serious delays. Employees have spent long hours on the road to prevent congestion, working on the last end of their trips with only half a will, making the movement of their trains probably less expeditious than if they had a pecuniary incentive to make every effort to reach the terminal with as

heavy tonnage as could be handled and with as rapid dispatch as possible.

Recent conditions have naturally given large figures on the ton mile basis, as the element of time is eliminated in a measure, and indeed on the present basis of pay for train and engine men, economy in operation is obtained unless the hours on the road are so excessive as to increase the cost of running such trains, per 1,000 ton miles, due to overtime made by the crews.

What would be the result as shown by ton mile statistics if the element of time were considered, and how would this affect the wages of the men handling the trains and the movement of traffic and equipment for the public and the road?

Assume, for example, one division of a railway 100 miles in length and equipped with certain Class A engines, rated at 1,000 tons.

Case I.—Train and engine crew A can take with a Class A engine 1,000 tons over a 100-mile division in 10 hours.

Case II.—Train and engine crew B can take with a Class A engine 1,000 tons over the same division in 8 hours. Obviously the ton mileage of both trains (100,000-ton miles) is identical, as is also the engine and train mileage. There is no question, however, as to which crew has done the better work, assuming the dispatching and other conditions the same in both cases.

Case III.—Suppose train and engine crew C takes the same tonnage over the same division, under similar conditions, in 12 hours.

In Case III. the ton mileage (100,000-ton miles) is the same as in Cases I. and II., but the cost to the railway company per 1,000-ton miles is greater for wages in Case III. than in Cases I. or II., assuming that the crews draw overtime after 10 hours on the road. The cost for wages per 1,000-ton miles in Cases I. and II. is identical, yet we have the apparent anomaly that the men who do the best work derive less pecuniary benefit from the company than the men who do the poorest, unless it be considered that crew B is relieved earlier.

Assume now that these crews are to be paid for work they actually do, which results in a direct benefit to the railway company, i. e., combine the elements time, distance and force for a basis of pay.

Case Ia—A makes 100,000-ton miles in 10 hours or 10,000-ton miles per hour.

Case IIa—B makes 100,000-ton miles in 8 hours or 12,500-ton miles per hour.

Case IIIa—C makes 100,000-ton miles in 12 hours or 8,333-ton miles per hour.

If the crews were paid on a unit basis of "1,000-ton miles per hour," crew B would earn more money for themselves and the company than either A or C, the latter earning the least. The above was assumed for a 100-mile division of a railway, and if applicable to this portion it should be applicable to the road as a whole.

Assume that the road has 10 such divisions with similar conditions applicable to each and handled by three classes of men as outlined above. In through traffic over the entire line the following would obtain:

Case Ib—Crew A makes 1,000,000-ton miles in 100 hours.
Case IIb—Crew B makes 1,000,000-ton miles in 80 hours.
Case IIIb—Crew C makes 1,000,000-ton miles in 120 hours.

Equating the three cases to the basis of what crew C can do by making the element of time equal:

Case Ic—Crew A makes 1,200,000-ton miles in 120 hours.
Case IIc—Crew B makes 1,500,000-ton miles in 120 hours.
Case IIIc—Crew C makes 833,300-ton miles in 120 hours.

It is apparent therefore that but little more than half the equipment and power is needed to move the same traffic with crew B as with crew C. This, of course, will apply equally well under the present conditions of ton mileage, but would not employees running trains and engines over the road be stimulated to haul heavy tonnage and make better time if their rate of pay was based on a power basis instead of a mileage or time basis? Would not continual complaints from engine and train crews remedy difficulties on the road which cause delay now? Would not dispatchers make every effort to avoid delays to escape the annoyance and extra work caused by continual complaints which would originate with the men if delayed on the road? Would the motive power department have any peace if their engines and rolling stock were not maintained in first-class condition? Would not the same stimulating effect be apparent on the maintenance of way department to keep slow orders, etc., to a minimum? Would not the employees engaged in running the trains be on the alert to discover means and ways to move greater tonnage in less time and each become an inspector for defects that might cause delays? Would not the incompetent soon be discovered by his fellow employees and forced to retirement? Would the railway suffer extreme loss in case of delay? Would not the tonnage rating of engines for economical loading and speed soon adjust itself to the most efficient loading of the power? Would not the statistics compiled on a power basis be the true measure of the output of the railway and applicable to motive power accounts as well as conducting transportation?

Should motive power not be maintained on a basis of power (1,000-ton miles per hour) instead of on a basis of work (1,000-ton miles) or a basis of distance (mileage), as heretofore?

In fact, would a ton mile per hour basis for statistics not be elastic and fully applicable to the determination of all statistics in which the movement of trains is considered, and result in economy and efficiency both in a financial and educational manner for the railway and its employees?

If a full and impartial discussion of this subject through the medium of this journal can be obtained the object of this article will be accomplished.

WHAT "BIG ENGINES" MEAN.

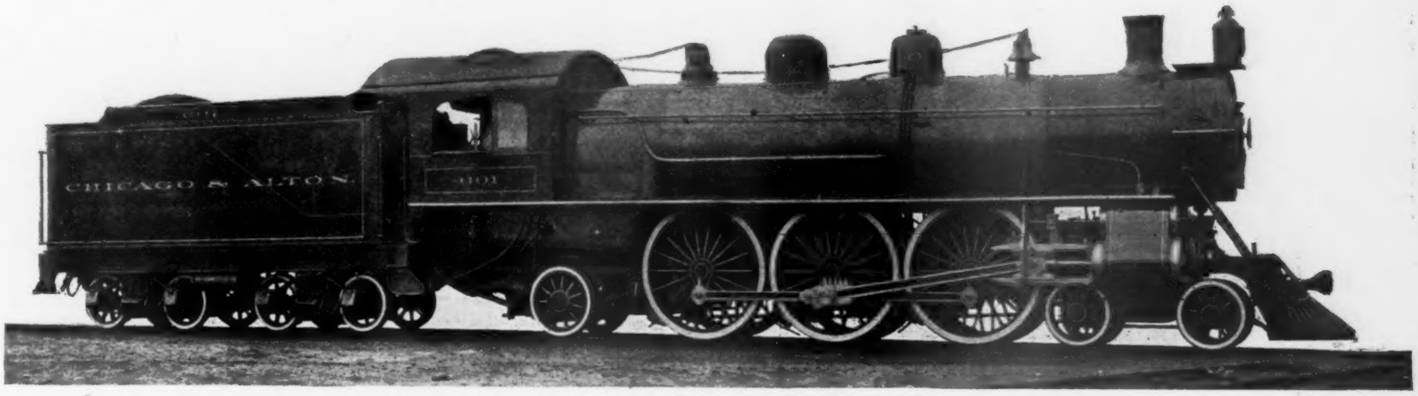
The new passenger locomotives for the Chicago & Alton described in this issue surpass all previous designs in size, weight and capacity. They have 4,078 sq. ft. of heating surface and carry 220 lbs. boiler pressure. They weigh 219,000 lbs. and have 141,700 lbs. on drivers, with 15,000 lbs. added to one of them by a traction increaser. One of them can produce a draw-bar pull of over 34,000 lbs., and this is for passenger service. In the details of construction are found 10 x 12-in. main driving journals and 7 x 7-in. crankpins for the main rod connections. There is nothing of the monstrosity order about these engines. They were built to do certain definite work which the most powerful passenger engines previously built cannot do. It must therefore be granted that such enormous proportions are necessary. There is nowhere the least hopeful sign that passenger equipment will decrease in weight or that requirements of passenger service will be less rigorous. This means that the railroads will soon be face to face with inadequate facilities for dealing with many heavy engines and the problem of efficient and sufficient shops becomes more vital and more important every year. The locomotive is to-day in advance of the tracks, the bridges, the side-tracks, the water service, the car-draft gear and the shops, and this is a situation requiring the immediate attention of the business men who are directing the operations of railroads. In the matter of shops allow us to direct attention to the fact that many built within the past two years are already "back numbers." It will not be long before the ability of railroad officers will be measured by their treatment of this problem. The advent of such large and heavy engines, which is suggestive of the necessity of quick and economical work in maintenance, calls attention to this subject in a new and forcible way.

POWERFUL PASSENGER LOCOMOTIVE.

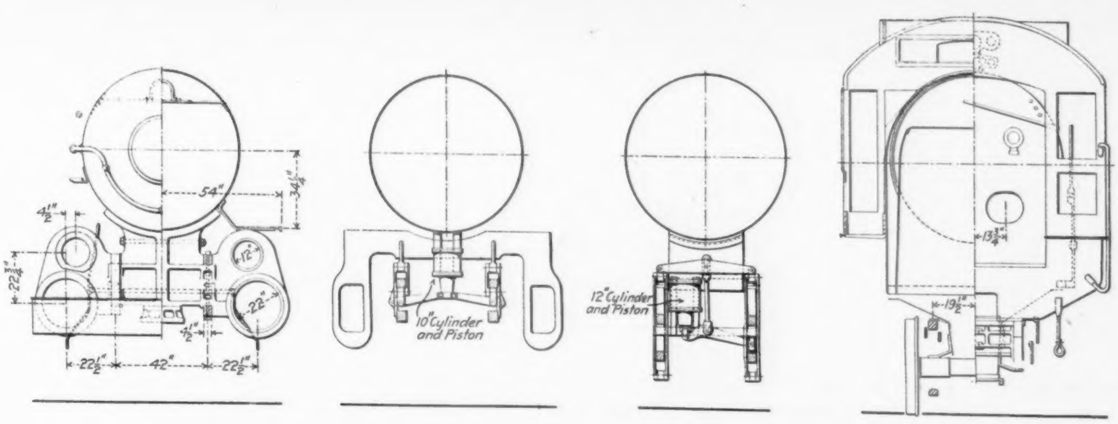
4—6—2 Type.

CHICAGO & ALTON RAILWAY.

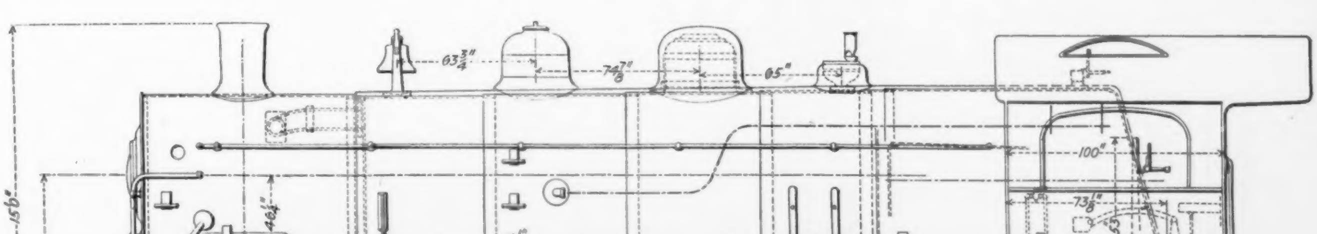
The Baldwin Locomotive Works have built for this road two passenger locomotives which head the list of designs for this service, with reference to weight, power and heating surface. They are intended especially for very heavy and comparatively slow passenger excursion trains to be run in connection with the approaching exposition in St. Louis. One of them has 80-in. drivers and the other 73-in., the latter being equipped with a modified Player traction increaser which transfers about 15,000 lbs. from the leading and trailing trucks to the driving wheels. The accompanying photograph, drawings and comparative table give an excellent idea of the proportions and power of these remarkable locomotives. It is interesting to note that though the front tube sheet is well back, the tubes are 20 ft. long, thus fulfilling the prophecy of Mr. Vauclain of two years ago. The smoke-box is 101 ins. long. Those who have been striving to reduce the size of smoke-boxes will watch the effect of this feature with interest. The tender, having capacity for 8,400 gals. of water and 9 tons of coal, is the largest ever built at the Baldwin Works. It should be stated that before deciding upon the proportions of these engines the officers of the road borrowed the heaviest and most powerful passenger engines in the country, and from exhaustive tests decided that none of them would meet the conditions required. This meant that a larger than the largest



THE MOST POWERFUL PASSENGER LOCOMOTIVE EVER BUILT.



THE TRACTION INCREASER CYLINDERS ARE LOCATED IN FRONT OF FIRST AND IN REAR OF THIRD DRIVING AXLES.
Their use is controlled by the position of the reverse lever.



POWERFUL PASSENGER LOCOMOTIVE, 4—6—2 TYPE.—CHICAGO & ALTON RAILWAY.

A. L. Humphrey, *Superintendent of Motive Power.* Baldwin Locomotive Works, *Builders.*

must be built, which explains the great advance in weight and heating surface over previous practice. These enormous locomotives were therefore built for definite conditions involving trains of twenty or more cars, and not in any sense to surpass others in size.

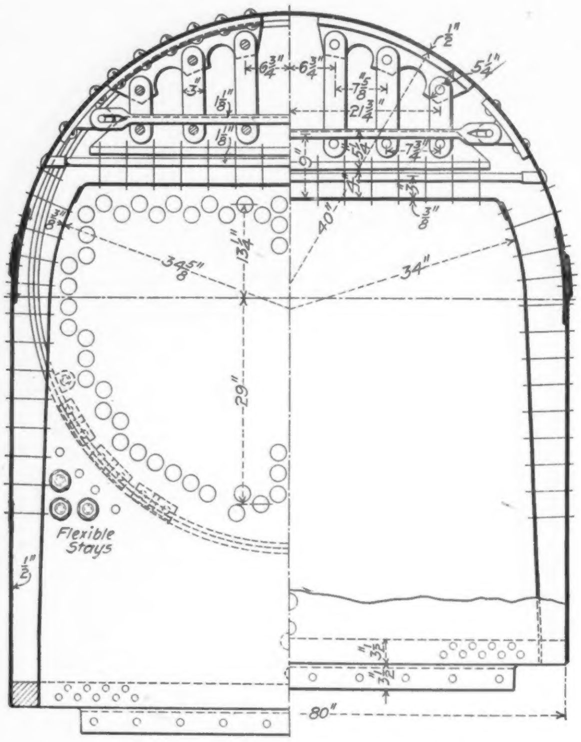
The trains these engines are to haul will consist of twelve passenger cars and weigh approximately 600 tons, without passengers and baggage. This train will accommodate conveniently 760 people, which would increase the weight 57 tons, and, allowing 15 tons for baggage, would make the train weigh nearly 675 tons. The distance this train is to be hauled is 110.6 miles, and is to be made in 2½ hours, including two stops and three slow-ups for railroad crossings. Making an allowance of six minutes for all stops, the actual running time would be 2 hours and 24 minutes. This would mean an average speed of 46 miles per hour. Before deciding on the size of engines to do this work a test was made between three different Prairie type engines, one a four-cylinder compound and the other two simple engines. The most important dimensions of these three different engines are as follows:

No Engine.	Size of Cylinders.	Diameter of Drivers.	Inside Diameter of Boiler.	Size of Fire-box.	Steam Pressure.	Grate Area.	Total Heating Surface.	Weight on Drivers.	Tractive Power.
	ins.	ins,	ins.	ins.	lbs.	sq. ft.		lbs.	
1	17 & 28 x 28	69	70	71¼ x 108	200	53.5	3,738	141,600	31,537
2	20⅛ x 28	80	64¾	84 x 85	200	48.6	3,343	130,000	24,990
3	20 x 28	75	66½	72 x 102	200	51.	3,534	140,200	25 386

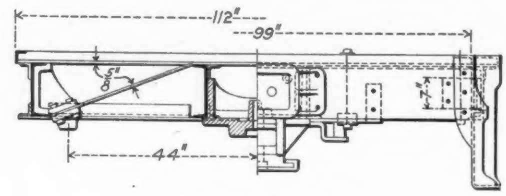
The conclusion reached from the test was that to do this work an engine about 15 per cent. more powerful than engine No. 2 was needed, and these heavy engines were designed accordingly.

RATIOS, CHICAGO & ALTON 4—6—2 TYPE.

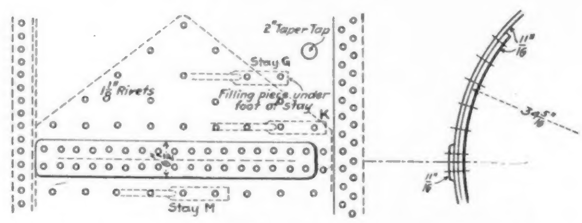
Tractive effort 80-in. wheels	31,600 lbs.
Tractive effort 73-in. wheels	34,600 lbs.
Heating surface to cylinder volume	331.00
Tractive weight to heating surface	34.74
Tractive weight to tractive effort (80-in.)	4.48



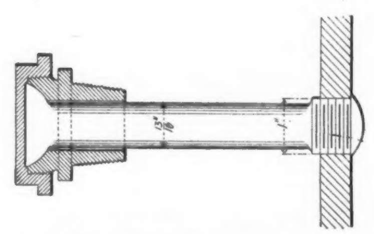
THE FIRE BOX, SHOWING CROWN STAYING.



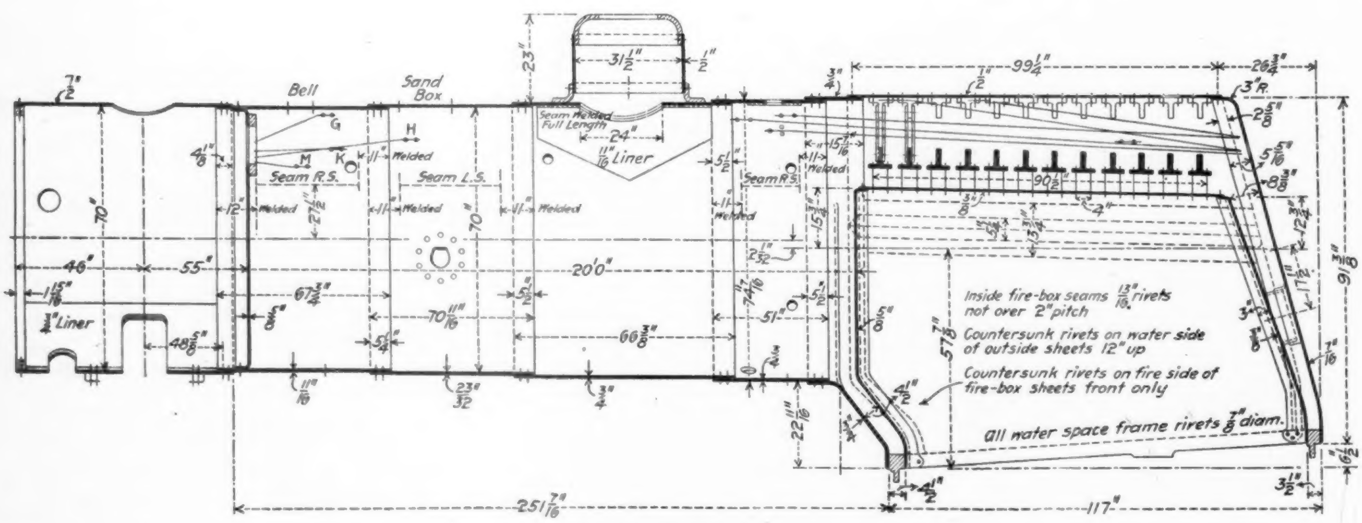
TENDER BODY BOLSTER.



SEAM IN FRONT COURSE (SEE LONGITUDINAL SECTION.)



FLEXIBLE STAYBOLT USED IN THROAT.



LONGITUDINAL SECTION OF BOILER.

POWERFUL PASSENGER LOCOMOTIVE.—CHICAGO & ALTON RAILWAY.

Tractive effort to heating surface	7.74
Heating surface to grate area	75.5
Tractive effort × diameter of drivers to heating surface	619.2
Heating surface percentage of tractive effort	12.8
Total weight to heating surface	53.7

COMPARISON WITH OTHER LARGE PASSENGER LOCOMOTIVES.

Name of Road.	Engine Number.	Total Weight (Lbs.)	Total Heating Surface (Sq. Ft.)	Total Weight Divided by Heating Surface.
Chicago & Alton	601	219,000	4,078	53.7
Santa Fe	1000	190,000	3,738	50.1
New York Central	2980	176,000	3,505	50.2
Chesapeake & Ohio	147	187,000	3,533	52.9
Lake Shore	650	174,500	3,343	52.2
Chicago & Northw't'n.	1015	160,000	3,015	53.1
Northern Pacific	284	202,000	3,462	58.3

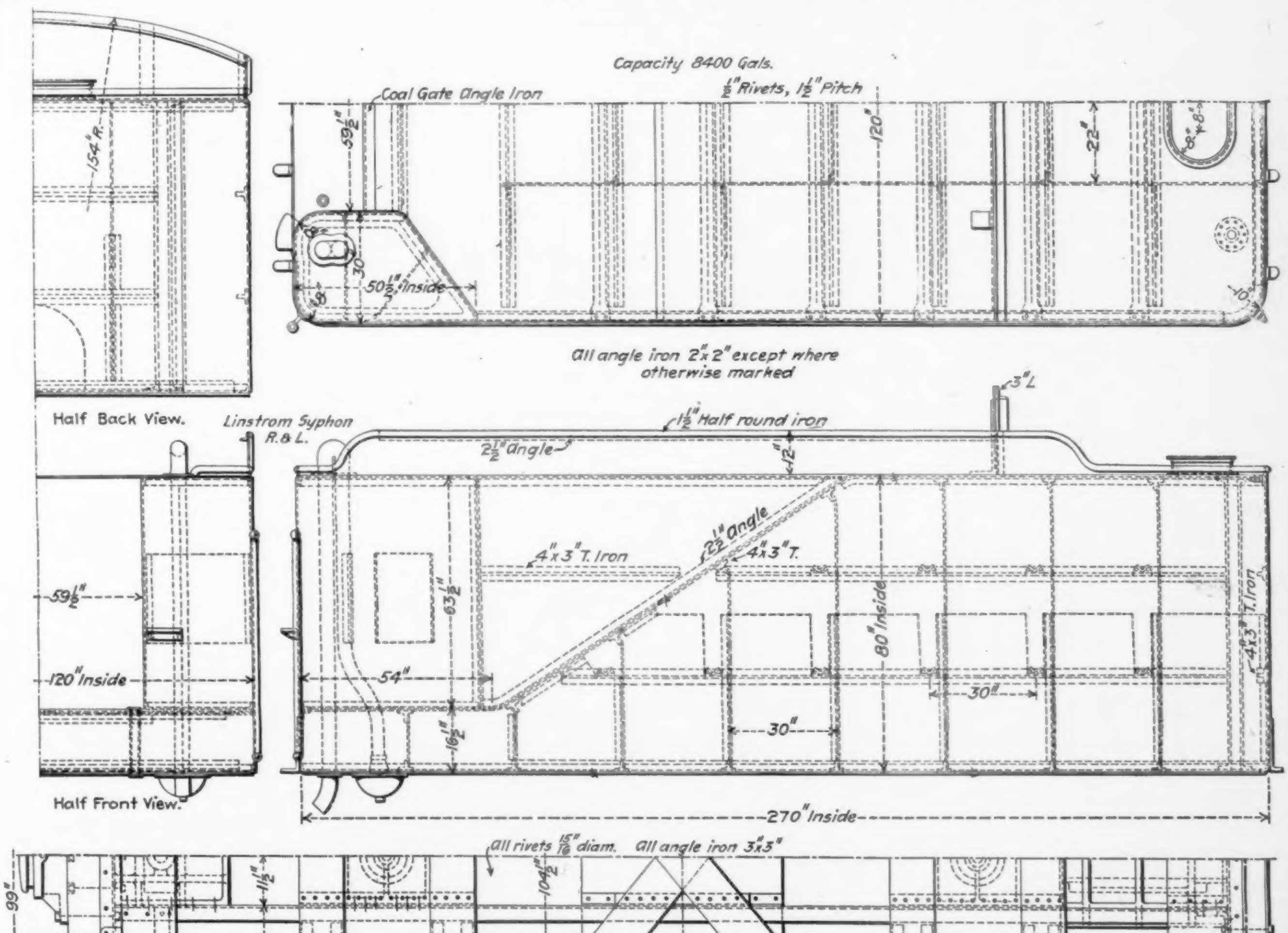
CHICAGO & ALTON RAILWAY.

4—6—2 Type Passenger Locomotive.
General Dimensions.

Gauge	4 ft. 8½ ins.
Cylinder	22 x 28 ins.
Valve	Balanced piston
Boiler—Type	Straight
Diameter	70 ins.
Thickness of sheets	11-16 in., 23-32 in. and ¾ in.
Working pressure	220 lbs.
Fuel	Soft coal
Staying	Crown bar, 5¼-in. x 6-in. T-section
Firebox—Material	Steel
Length	108 ins.
Width	72¼ ins.
Depth	Front, 73⅝ ins.; back, 64⅛ ins.
Thickness of sheets: Sides, ⅜ in.; back, ⅜ in.; crown, ⅜ in.; tube, ⅝ in.	
Water space	Front, 4½ ins.; sides, 3½ ins.; back, 3½ ins.
Tubes—Material	Iron
Wire gauge	No. 11
Number	328
Diameter	2¼ ins.
Length	20 ft.
Heating surface—Firebox	202 sq. ft.
Tubes	3,848 sq. ft.
Firebrick tubes	28 sq. ft.
Total	4,078 sq. ft.
Grate area	54 sq. ft.
Driving wheels—Diameter outside	73 ins. and 80 ins.
Diameter of center	66 ins. and 73 ins.
Journals	Main, 10 x 12 ins.; others, 9 x 12 ins.
Engine truck wheels (front)	Diameter, 33 ins. on No. 1, 36 ins. on No. 2
Journals	6½ x 13 ins.
Engine truck wheels (back)	Diameter, 42 ins
Journals	8 x 12 ins.
Wheel base—Driving	13 ft. 9 ins.
Rigid	13 ft. 9 ins.
Total engine	32 ft. 8 ins.
Total engine and tender	62 ft.
Weight—On driving wheels	141,700 lbs.
On truck (front)	36,300 lbs.
On truck (back)	41,500 lbs.
Total engine	219,000 lbs.
Tank—Capacity	Coal, 9 tons; water, 8,400 gals.
Tender—Wheels	Number, 8; diameter, 36 ins.
Journals	5½ x 10 ins.

Mr. C. P. Coleman has resigned as purchasing agent of the Lehigh Valley Railroad, and will engage in business. The duties of his office will be performed by Mr. J. A. Middleton, second vice-president, at his office at 39 Cortlandt street, New York City.

Mr. W. J. Taylor, of the Taylor Iron and Steel Company, died February 17 at his home in Bound Brook, N. J., after an illness of only a few days. He was widely known as one of the pioneers in the manufacture of car-wheels.



TENDER FRAME AND 8,400 GALLON TANK.

POWERFUL PASSENGER LOCOMOTIVE.—CHICAGO & ALTON RAILWAY.

EXTENSIVE SHOP IMPROVEMENTS.

JACKSON, MICHIGAN.

MICHIGAN CENTRAL RAILROAD.

THE POWER PLANT.

One of the most important features of the extensive improvements under way at the locomotive repair shops of the Michigan Central Railroad, at Jackson, Mich., is the introduction of the electrical system of distribution of power, together with the installation of a very complete central power plant, which will not only supply all the lighting and the power for the machine tools, cranes, etc., at the shops, but will furnish current for the electric lighting of the union depot and freight department buildings in the center of the city, about a mile away, and also for the night lighting of the extensive yards located in the eastern section of the city. This power plant, which has recently been completed and placed in service, has replaced four separate isolated power plants of boilers and engines which were scattered around adjoining various shop buildings—the machine shop, the blacksmith shop, the carpenter shop and the roundhouse.

A departure from the more usual method of power distribution is an important feature of this installation, in that the three-phase alternating-current system is used rather than the direct-current system. This was due partly to the desire to supply current for the lighting at the depot buildings, the transmission to which required a rather high voltage on account of the distance—for this the alternating current is particularly applicable as, unlike direct-current, it may be transformed up to the high voltage at the power plant and then transformed back down at the point of consumption, thus confining the dangers of the high voltage to the transmission line only and still deriving the advantages of its high economy in transmission. Another important advantage accompanying this, however, is that due to the extreme simplicity and durability of the induction motor on account of its freedom from brushes or other exposed contacts, there being nothing but short-circuited windings on the rotor or rotating part.

The power plant building is of substantial steel and brick construction, with inside dimensions of 89 ft. north and south and 85 ft. east and west. The south 50 ft. of the building is devoted to the boiler room, and the north 38 ft. and 11 in. to the engine room, a 13-in. brick wall dividing the two rooms. The height from the floor of the boiler room to the bottom chord of the roof trusses is 24 ft., and the height to the top inside of the monitor over the boiler room, 43 ft.; the height from the engine room floor to the roof trusses is 22 ft. The walls are brick on concrete foundations, the roof being expanded metal and cinder concrete carried on steel roof trusses. The monitor is also of steel construction, with expanded metal and concrete roofing. The engine room is ventilated by 6 large Pancoast ventilators.

The floors in both the engine and boiler room are built of cinder concrete with cement dressing, in all 6 ins. thick, the engine room floor level being 2 ft. above that of the boiler room and not excavated. Brick pilasters support the roof trusses and also the crane runway in the engine room; the crane has a span of 37 ft. 2 ins., and is of 7½ tons capacity, operated by hand power. A concrete lined tunnel, 6 ft. in the clear inside height and 4 ft. 6 ins. wide outside of pilasters, extends the entire length of the engine room adjoining the division wall; the roof of this tunnel is expanded metal and concrete supported on 5-in. I-beams. A further tunnel extends from this cross tunnel on the line C-D, shown in the accompanying floor plan, to a point in front of the air pumps, this tunnel being covered by checkered steel plates.

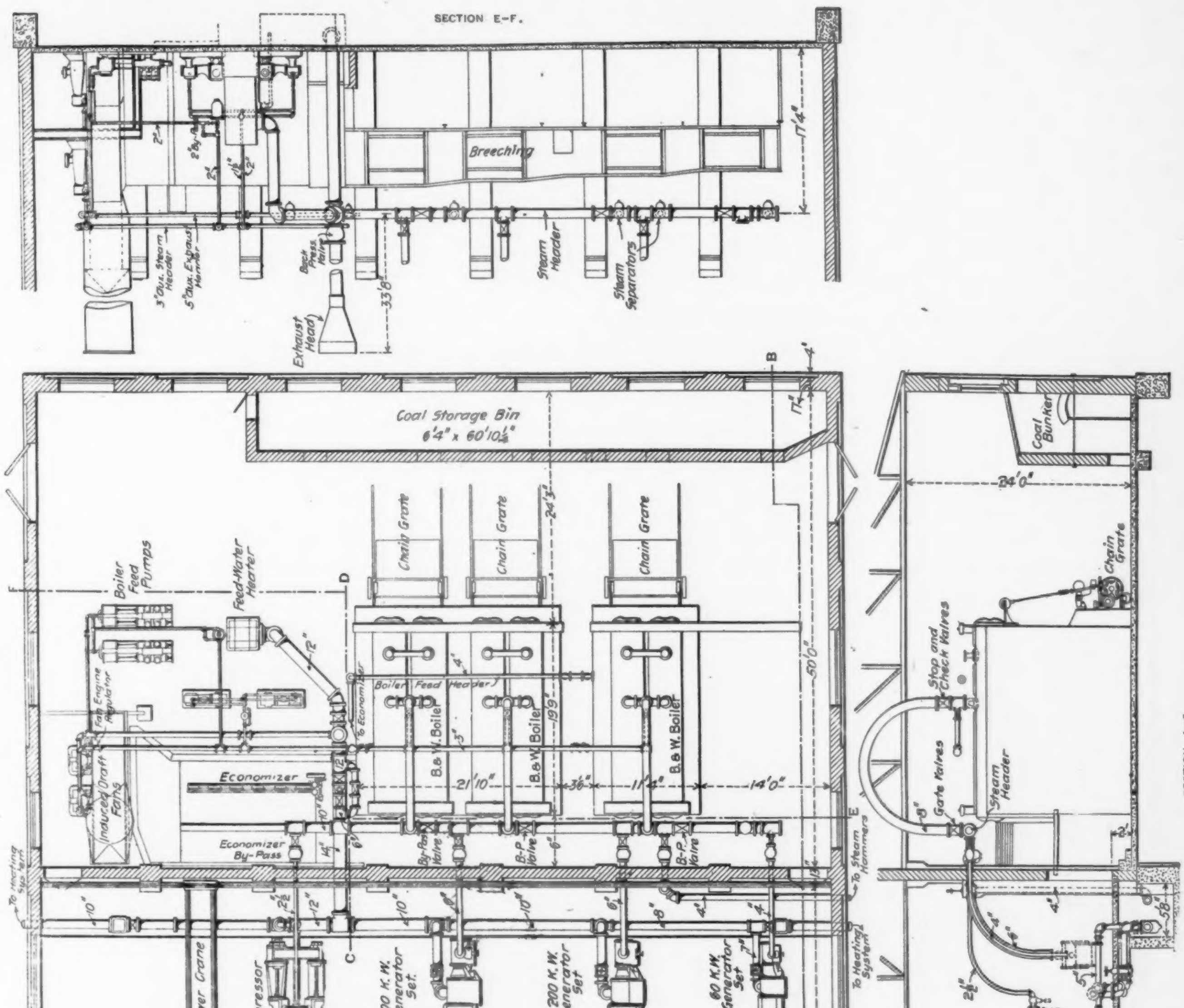
The boiler equipment consists of three Babcock & Wilcox water-tube boilers of their vertical header type, each boiler having 2,640 sq. ft. of heating surface and rated at 264 h.-p. They are set in batteries of two, one battery having at present, however, only a single boiler, provision being made for the addition of a fourth boiler to complete that battery at some future time. A view of the boilers is presented on page 93, which engraving also shows the Green stokers.

All three of the boilers are equipped with automatic stokers of the link grate type made by the Green Engineering Co., of Chicago, Ill. Each stoker has a free width of grate over the traveling links of 7½ ft. and the effective grate area is 67½ sq. ft. presented between the front housings and the arch. The traveling link portion of the grate is driven, at a very slow rate, by power from a shaft above, through an eccentric and ratchet mechanism, the shaft being driven by a small vertical engine on top of the coal bunkers; an engine was here preferred to a motor to permit starting before dynamos are running. The framing of the stokers' mechanism is very substantial, and a smoke arch of novel design is used, having the supporting framework far removed from the heat of the fire. The stokers are arranged for hand feeding from the floor, the coal being stored in the large bunker shown at the south side of the boiler room—see floor plan on page 89. The coal is shoveled direct into these bunkers from the cars on a slightly elevated track outside the building, and is drawn out for firing through feeding holes at the floor on the boiler-room side.

Particular attention is called to the automatic self-cleaning feature of the traveling link grate. The fuel is fed onto the grate at the front and is slowly carried toward the rear, during which it burns progressively; the speed of travel is so adjusted that the fuel is completely burned as it is dumped off the grate at the rear. This feature of dumping as the links pass over the rear drum of the carrier mechanism causes the grates to be self-cleaning and absolutely prevents any clogging or trouble from clinkers. When properly installed and handled these grates consume the fuel practically smokelessly. Thus, while of considerable greater first cost than ordinary grates, they will burn fuel smokelessly and economically, and are operated much more economically than plain grates.

The waste fuel gases are carried from the boiler to the economizer through a wrought steel breeching, built up of ⅛-in. steel plate with angle-iron stiffeners. The economizer, which has a capacity sufficient for four boilers of the size installed, has 192 vertical tubes, presenting a total of 2,400 sq. ft. of heating surface for heating the feed-water from the waste gases; it was installed by the Green Fuel Economizer Company, Matteawan, N. Y. A by-pass is arranged around the economizer which may lead the waste gases from the breeching direct to the induced draft fans, if it is desired for any reason to cut the economizer out of use. The gases are deflected into either path by a swing damper of novel construction mounted upon roller bearings placed outside of the smoke-flue and which therefore will not deteriorate through the action of the hot gases and thus will always swing easily. At the outlet end of the economizer there is arranged a louvre damper, which may be closed when the economizer is shut down for repairs in order to keep it free from the gases. Details of the economizer and the by-pass damper are shown in the drawings on page 91.

The induced draft apparatus, which is located in the northeast corner of the boiler room, consists of two 7-ft. blast fans operated by direct-connected vertical steam engines, together with the steel stack and connections, all of which were furnished by the B. F. Sturtevant Company, Boston, Mass. The fans are arranged one above the other for economy of space, as shown in the elevation drawings of the boiler room, the upper fan and its engine being supported upon a steel platform of I-beams 9 ft. 4 ins. above the floor. Each fan is driven by a single engine, with cylinder 8 ins. in diameter by 6-in. stroke, of the well-known vertical inclosed type of the



FLOOR PLAN OF POWER PLANT AND ELEVATION VIEWS OF THE ENGINE AND BOILER ROOMS.

JACKSON SHOPS POWER PLANT.—MICHIGAN CENTRAL RAILROAD.

E. D. BRONNER, *Superintendent of Motive Power.*

C. H. WILMERDING, *Consulting Engineer.*

Sturtevant Company's make, the blast wheel of the fan being mounted directly upon an extension of the engine's shaft. The blast wheels are each 84 ins. in diameter with 42 ins. face, each fan having a delivery outlet 42 x 48½ ins. in section. Each fan is provided with tight-shutting louvre dampers at the inlet side for cutting it out of service, and the bearings for the engine and fan shaft are all removed from contact with the hot gases and are water-cooled besides to prevent interruptions of service by overheating. Either fan is capable of carrying the load for all of the boilers, the extra fan being installed for reserve to permit shutting one down for repairs at any time. The steel stack is 60 ins. in diameter inside and extends to a height only 48 ft. 5 ins. above the boiler-room floor. This elimination of the high stack, otherwise necessary, with its attendant high first cost and expense of maintenance, is an even greater advantage of the induced draft system than that offered by its remarkable ability to force the boilers to meet sudden and unexpected demands.

The arrangement of the steam piping is shown in the cross-section view of the power plant. The main steam header is supported back of the boilers and over the breeching upon a specially designed pipe gallery and is 10 ins. in diameter throughout its length. The steam is taken from the boilers through Davis automatic stop and check valves, which will close in case of accident to the boiler or piping, and through an 8-in. pipe bend to a gate valve located on top of the header. The connections to the engines are provided with gate valves at the point where they leave the header, next to which are placed steam separators. The pipes then are carried on a bend of 90 deg. to the engine throttles. An auxiliary steam header 3 ins. in diameter is connected immediately above the stop and check valves through gate valves from each boiler. This auxiliary header is used for the supply of steam to the boiler feed pumps, to the induced-draft engines, the engines for operating the stokers, and to the automatic pumps used in connection with the heating system. Also a 4-in. pipe line is run from the main header to the blacksmith shop to supply the steam hammers.

The main exhaust header is carried in the tunnel under the south side of the engine room and receives exhaust from the engines underground. A 14-in. connection is made through the tunnel leading into the boiler room from the main exhaust header to the open feed-water heater and to a riser extending up through the roof and provided with a back-pressure valve and an exhaust head for free exhaust. The back-pressure valve, located in the exhaust riser just above the heater connection, is a Kieley valve, which will open in case the heating system cannot take care of all the exhaust steam, causing a pressure to back up toward the engines. The exhaust from the auxiliaries is also brought in to the main steam pipe below this back-pressure valve. A cross-connection is made from the steam header to this vertical riser through a pressure-reducing valve, which enables live steam to be furnished to the exhaust system for heating in case of necessity.

The piping is of standard wrought-iron pipe, the high-pressure lines being equipped with extra heavy fittings. The valves throughout are of Chapman make, except the pressure-reducing valve and the back-pressure valve, which are Kieley valves, and the automatic stop and check valve and the fan regulator valve on the steam connection to the fan engines, which are of G. M. Davis Regulating Company's manufacture. For the automatic return of the condensed water accumulating in the high-pressure steam pipe, the separator receivers, and at the engine throttles, the Holly system is used. All piping is covered with the H. W. Johns-Manville Company's asbestos sponge-felted covering.

The fan-regulator valve controlling the fan engines is an interesting feature of the boiler equipment. It is inserted in the steampipe leading to the fan engines and set for the desired pressure to be carried on the boilers. Normally the valve is open until the pressure rises and overcomes the weighting, when it slowly closes and slows down the engine driving the fan. When the pressure drops the valve opens and allows the engine to speed up again, thus automatically keeping the boiler pressure at as near a fixed point as the regulation of induced draft will accomplish. The regulator is provided with an adjustment arrangement so that the valve throw may be limited and the maximum and minimum speed of the engine may be fixed. It is found best to adjust the throw of the valve not to shut off entirely, so as to keep the engine moving and thereby avoid dead centers.

The boilers are fed by two Worthington 7½ x 4½ x 10-in. outside-packed pressure-pattern feed-pumps, which draw water from a Webster vacuum heater of 1,200 rated horse-power capacity.

HEATING SYSTEM.

The main exhaust header in the engine-room tunnel extends the full length of the building and out underground at each end through a Webster oil separator. These pipes form the mains for the heating system throughout the entire plant. The return pipes are brought in through this tunnel at each end and are carried into the boiler room to the two vacuum pumps. The shops had formerly been heated by live steam direct from boilers, while all exhaust steam had been allowed to escape to the atmosphere. In the new plant, with the installation of new engines of much greater capacity than formerly used, the exhaust steam from them, together with that from the hammers in the blacksmith shop, was considered too valuable to throw away. After looking into the merits of the various methods and systems of heating and circulating steam, the Webster system was adopted and is now in successful operation.

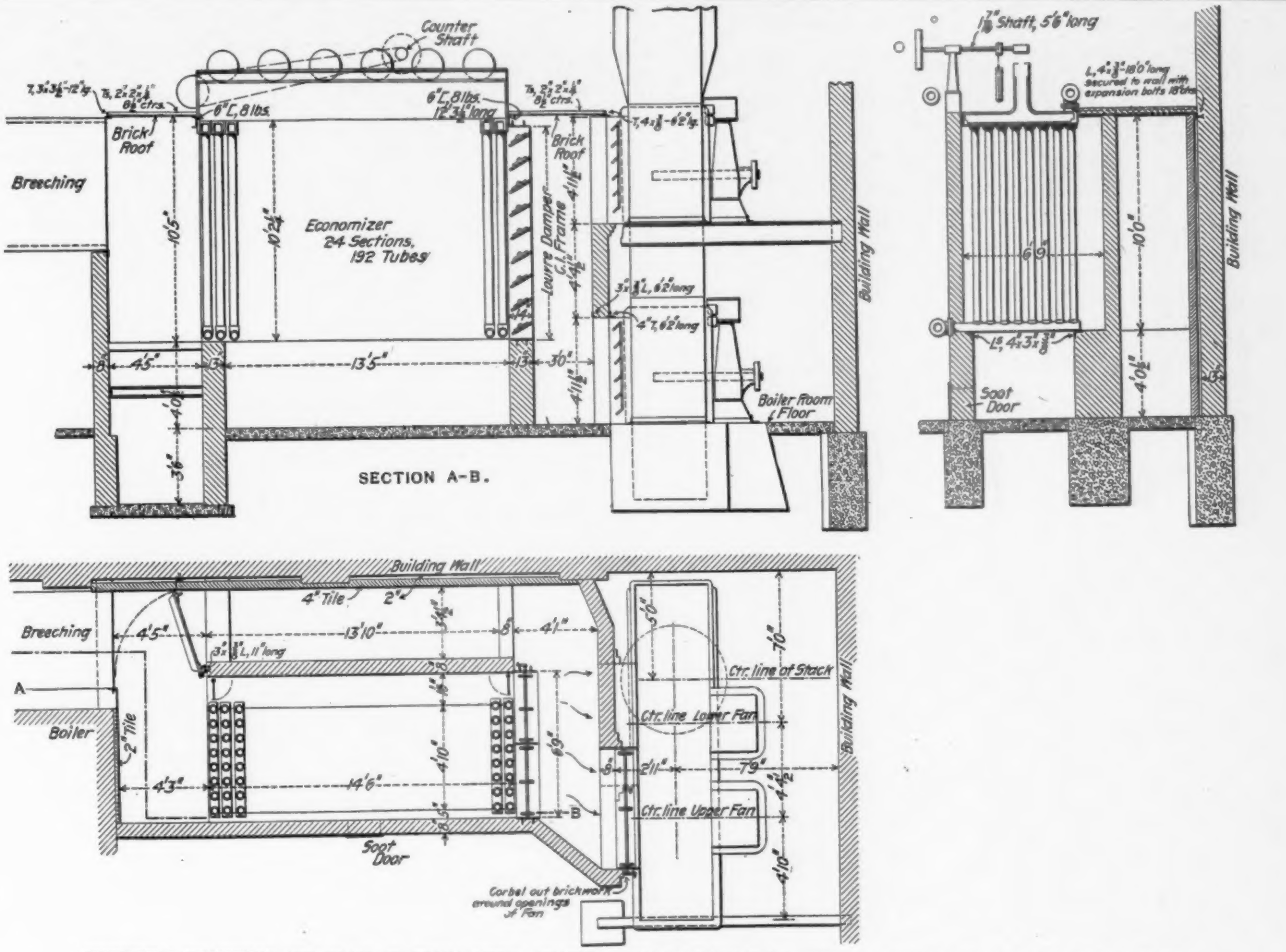
The locomotive and machine shops, which are both under one roof, contain in all 3,300,000 cu. ft. of air, and for heating there has been installed two fans and large groups of blast coils, containing in all 21,000 lineal feet of 1-in. pipe. These fans and coils are of the National Blower Company's manufacture. The other buildings in the group are heated by direct radiation in the form of wall or ceiling coils and cast-iron radiators, there being, all told, about 15,000 sq. ft. of direct heating surface with a cubical contents of buildings of about 2,000,000 cu. ft.

The supply piping is run from the power house to the nearest buildings, and between buildings, through tunnels and trenches; but is raised and suspended overhead inside the buildings. The system of return piping is all run in trenches under the ground or floors, and connections are made to these returns from every heating unit.

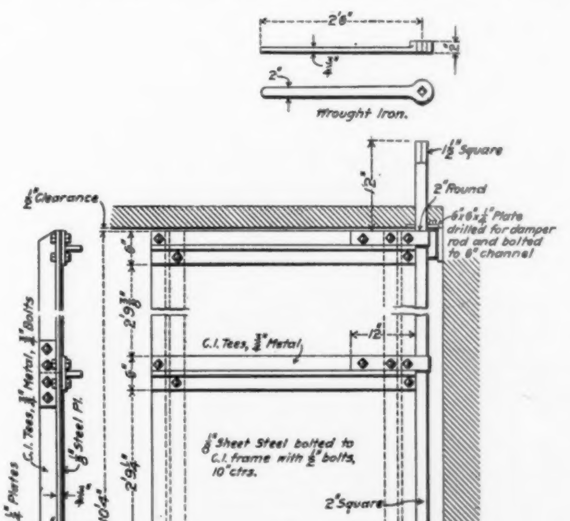
Two special vacuum pumps in the boiler room are connected to the main returns and are used to draw the water of condensation and air from the coils and radiators, the condensation being delivered into a Webster feed-water heater and purifier. The extraction of air and water from each radiator and coil is controlled by special Webster thermostatic water and air relief valves, attached to the return end of the unit in place of the ordinary air valves.

By the use of the Webster system, exhaust steam is used to the fullest extent, and when not sufficient is supplemented by live steam from the boilers under a reduced pressure. The circulation is accomplished under a pressure below that of the atmosphere, all air and water being extracted, the former escaping to the atmosphere and the latter entering the feed-water heater to be used again for boiler-feed purposes.

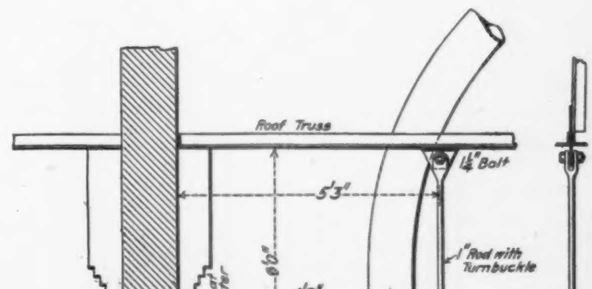
The heating plant was installed, under the supervision of Charles H. Wilmerding, consulting engineer, by Thomas & Smith, the heating contractors. The Webster system was installed under the supervision of the American Engineering Specialty Company, Chicago, Ill., Western agents of Warren Webster & Company.



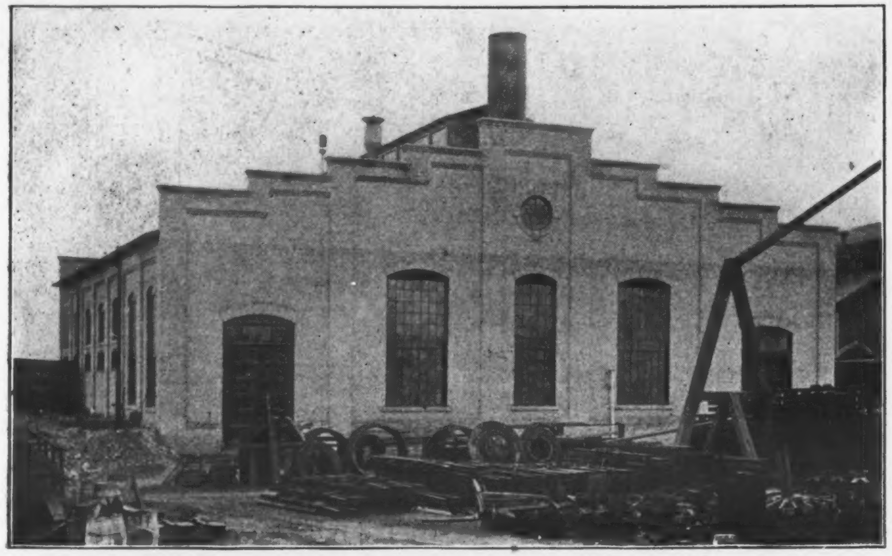
SECTIONAL DRAWINGS AND PLAN OF ECONOMIZER, SHOWING CONNECTIONS BY LOUVRE DAMPERS WITH THE EXHAUST FANS.



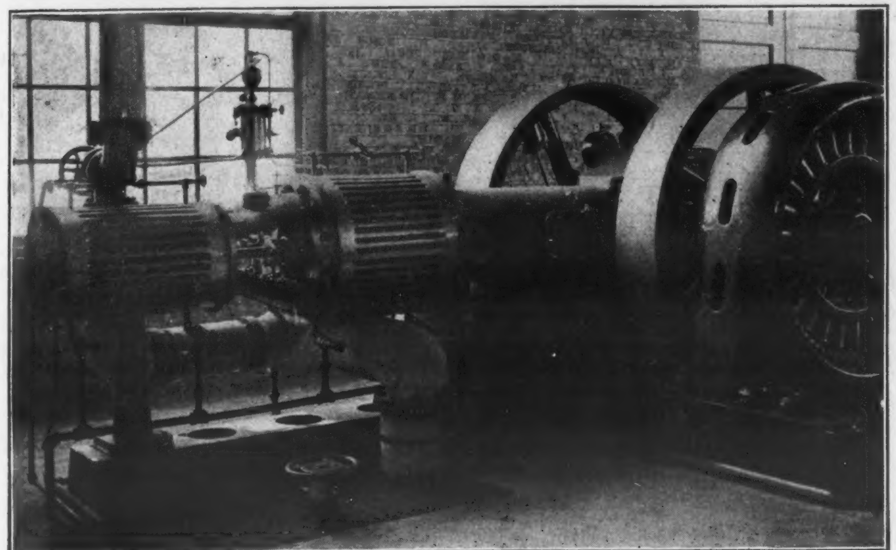
DETAILS OF BY-PASS DAMPER IN BREECHING AT ENTRANCE TO THE ECONOMIZER, SHOWING ARRANGEMENT OF ROLLER BEARING.



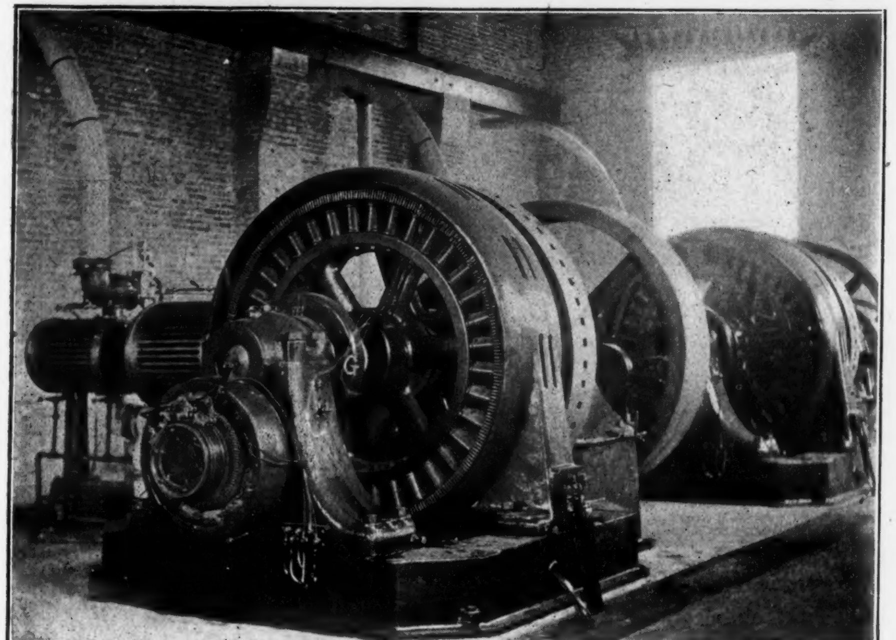
DETAIL OF PIPE GALLERY AT REAR OF BOILERS, SUPPORTING THE MAIN STEAM HEADER AND GIVING ACCESS TO ALL STEAM VALVES.



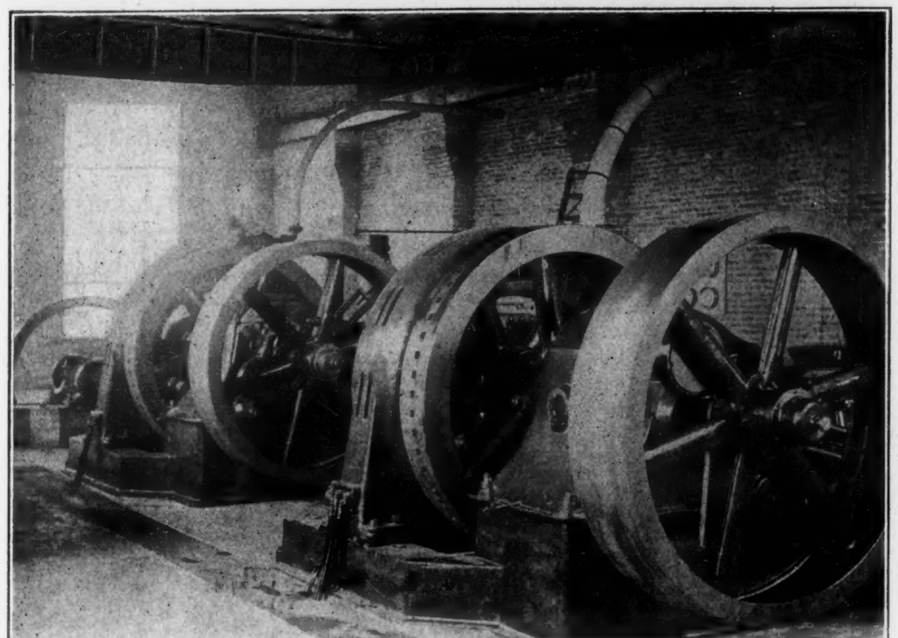
EXTERIOR VIEW OF POWER HOUSE—EAST END. SHOWING ARRANGEMENT OF OPENINGS INTO COAL BUNKERS ALONGSIDE OF ELEVATED TRACK.



THE 10 x 16 x 14 TANDEM COMPOUND BALL ENGINE, WHICH DRIVES THE 60-KW. STATIONARY ARMATURE GENERAL ELECTRIC GENERATOR.

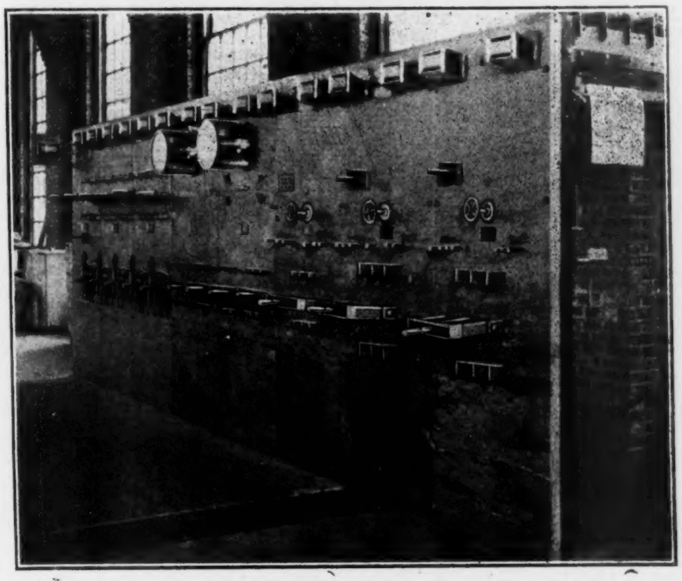


VIEW OF THE 200-KW. THREE PHASE GENERAL ELECTRIC ALTERNATOR, SHOWING METHOD OF DRIVING EXCITER THROUGH GEARING FROM GENERATOR SHAFT AT G.



GENERAL VIEW OF ENGINE ROOM SHOWING ARRANGEMENT OF ENGINE AND DYNAMOS, AND THE 7½ TON HAND CRANE.

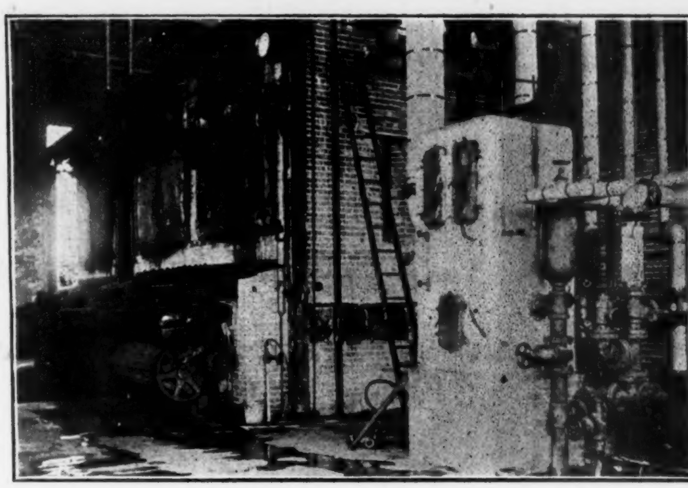
JACKSON SHOPS POWER PLANT.—MICHIGAN CENTRAL RAILROAD.



GENERAL ELECTRIC EIGHT-PANEL SWITCHBOARD, SHOWING WATTMETERS UPON THE TWO MIDDLE PANELS.

200-kw. machines, while that driven by the smaller engine is a 26-pole 60-kw. machine. A particular feature of these dynamos is the method of operating the compensating exciters by mounting upon the outboard bearing pedestal and gearing direct from the main shaft. The rating of these dynamos is on the basis of an increase in temperature not to exceed 25 deg. C. after a continuous full-load run of 24 hours.

The cables leading from the generators to the switchboard are carried in a checkered-plate covered trench in the floor, as shown in the generator view on page 92, which leads to a pit behind the board. The switchboard, which was built by the General Electric Company, consists of eight panels of blue Vermont marble, 90 ins. high by 32 ins. wide by 2 ins. thick, mounted on an angle-iron platform and braced out from the wall at a distance of 6 ft. Three of the panels are generator panels, two are lighting panels and the other three are power-feed panels. The board is equipped with two recording wattmeters, one for registering the power output and the other the lighting output. There are at the rear two sets of bus bars, one set for power and one for lighting. The power feeder panels are equipped with automatic oil switches. The cables from the generators are brought in under the switchboard to a pit 4 ft. 3 ins. deep, which is cov-



VIEW OF THE BOILERS, SHOWING TRAVELING LINK GRATES, FEED-WATER HEATER AND PUMP GOVERNOR.

VIEW OF BOILER FEED PUMPS, SHOWING ALSO ECONOMIZER AND INDUCED-DRAFT FANS IN PART.

JACKSON SHOPS POWER PLANT.—MICHIGAN CENTRAL RAILROAD.

The engine equipment consists of two tandem-compound horizontal engines, with cylinders 16 and 25 ins. in diameter by 18 ins. stroke, which run at 200 revolutions per minute, and a smaller tandem-compound engine, with cylinders 10 and 16 ins. in diameter by 14 ins. stroke, all three of which were furnished by the Ball Engine Company. They are all of the shaft-governor automatic cut-off type, and operate non-condensing at an initial steam pressure of 150 lbs. per square inch. They are all provided with synchronizing devices, by which they may all be brought to a common speed when the dynamos are being operated in parallel.

An old air-compressor moved from one of the previous power plants is installed in the engine room for present purposes. It is a Rand two-stage compressor, with inter-cooler, having 10 x 16-in. steam cylinders and 7½ and 14 x 16-in. air cylinders, delivering at a pressure of 120 lbs. The dimensions of the engine room, however, are such as to admit of the installation later of an air-compressor of 1,000 or 1,200 cu. ft. capacity, and also anadditional 200-kw. generating unit.

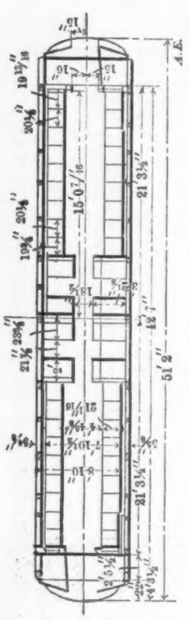
Each of the engines are direct-connected to an alternating-current three-phase, 60-cycle, compensating exciter type generator, with stationary armature and wound for 480 volts, all of which were built by the General Electric Company. The generators driven by the two larger engines are both 36-pole

ered over at the floor level with a wooden grating supported on steel I-beams. All outgoing feeders are taken out from the bottom of the board into the pit and led out in lead-covered cables underground.

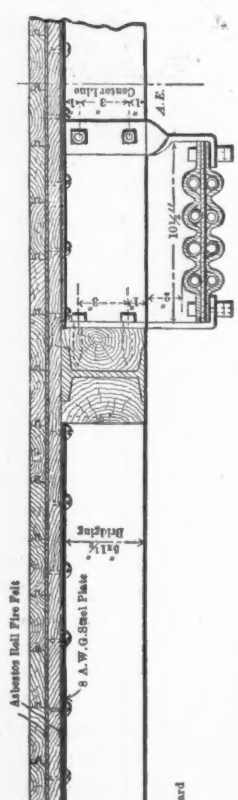
The present electrical load to be operated from this plant consists of 480 h.p. in motors driving machine tools, etc., 107 arc lamps and about 600 incandescent lamps, besides three alternating current cranes, two of 60 tons each with auxiliary 10-ton hoists, and one crane of 7½ tons capacity. The first two cranes are equipped with 45-h.p. motors for the main hoist and for the bridge travel, 30-h.p. motors for auxiliary hoist and 10-h.p. motors for trolley travel, while the 7½-ton crane is equipped with 11-h.p. motors for the main hoist and the bridge travel and a 3-h.p. motor for the trolley travel. The total connected load in motors, therefore, will be 743 h.p.

We are indebted to Mr. C. H. Wilmerding, consulting engineer, for drawings, information and assistance in the preparation of this description. Mr. Wilmerding designed the building and superintended its construction.

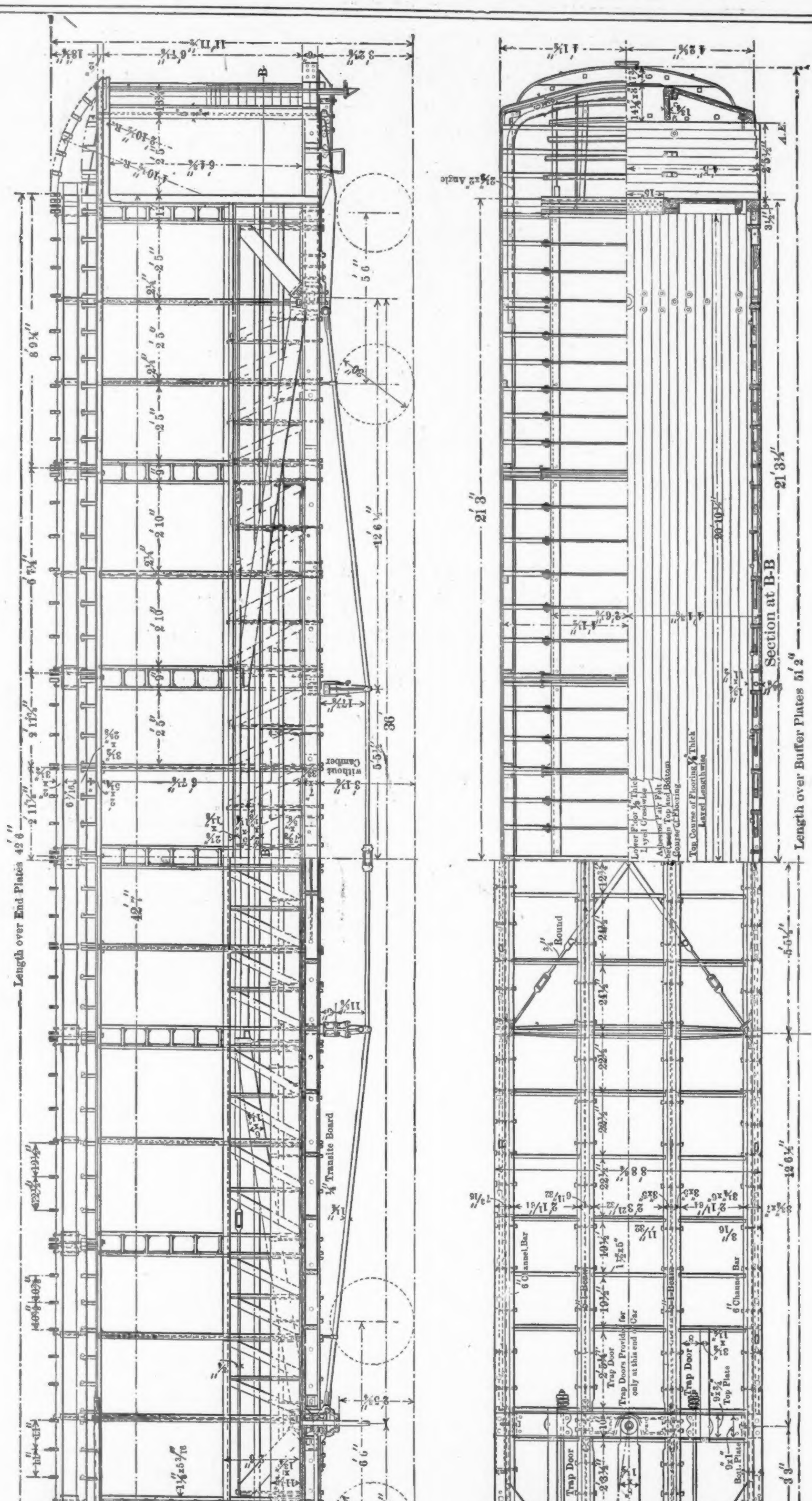
Mr. John N. Abbott has resigned as vice-president and general manager of the "Consolidated Railway Lighting and Refrigerating Company," 100 Broadway, New York, and has also dissolved his connection with the several subsidiary companies.



SEATING PLAN.



PARTIAL SECTION OF FLOOR, SHOWING "TRANSITE BOARD" SHEATHING.



FLOOR AND SIDE FRAMING.

PASSENGER CARS—INTERBOROUGH RAPID TRANSIT COMPANY, NEW YORK CITY.

NEW YORK SUBWAY CARS.

INTERBOROUGH RAPID TRANSIT COMPANY.

FRAMING AND CONSTRUCTION DETAILS.

Photographic views of the sample cars built for this road were illustrated on page 308 of this journal for October, 1902. Since that time the standard construction has been determined upon, and 500 cars are now being built, to be ready for service when the road opens next year. The details were worked out under the direction of Mr. George Gibbs, consulting engineer of the road.

General Dimensions.

	Ft.	Ins.
Length over body corner posts	42	7
Length over buffers	51	2
Length over drawbars	51	5
Center to center, needle beams	10	11
Width over side sills	8	8¾
Width over sheathing	8	10
Width of platforms	8	10
Width over eaves	8	6
Height, top of rail to under face of side sill at truck (car light)	3	1⅛
Height, top of rail to top of roof at center (car light)	12	¾
Truck centers	36	0
Diameter of motor truck wheels		33
Diameter of trailer truck wheels		30
Weight of car body (estimately)	27,000 lbs.	

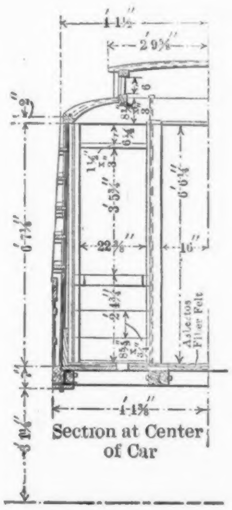
Steel Shapes in Frame.

Side sills	6-in., 8-lb. channels, 47 ft. 4¾ ins. long
Body end sills	5-in., 11½-lb. channels, 8 ft. 1¼ ins. long
Drawbar supports	4-in., 6¼-lb. channels, 3 ft. 4½ ins. long
Center sills	5-in., 12¼-lb. I-beams, 47 ft. 4¾ ins. long
Needle beams	5-in., 9¾-lb. I-beams, 8 ft. 6 ins. long
Platform supports	5-in., 16-lb. Z-beams, 4 ft. 6 ins. long
End bars in hood	2½ by 2 by ⅜-in. angles
Platform end sills	5 by 4 by ⅝-in. angles
Sector bars	6 by 3½ by ½-in. angles
Platform supports	6 by 4 by ½-in. angles

The bodies are the same for motor and trailer cars. The motor cars have one motor and one trailer truck. The difference in height due to the difference in the wheel diameters is made up in the truck design.

PLATFORMS.

The channels and beams in the longitudinal sills are secured to steel angles forming the platform end sills, to which are



Section at Center of Car

also attached the anti-telescoping plates and anti-telescoping posts. The latter extend and are secured to the steel angles forming the end bow reinforcements, which are secured to the end bows, with ends extending along the sides of the side plates in the car body and are secured thereto. The platform structure at each end is supported by Z-bars and angles, the Z-bars being bolted to the center sills and the angles to the side sills. These supports extend beyond the platform end-sill angles to support the platform sills and buffer beams. Two rods at each end of the car with threaded ends pass through the end-sill angles and end-wall castings for the platform trussing. The buffer beam is built up of white oak, and is secured to two oak timbers placed on the Z-bar supports and bolted to the bars and end-sill angle. A cast-steel drawbar carrier is bolted under the end-sill angle between the Z-bars. On each Z-bar is a sector bar support to which the steel angle sector bar faced with plate steel is bolted. On each side of the platform, resting in castings under the buffer beams and extending through the body bolster, is a safety chain anchor rod, with a spring seating against the body bolster filling casting.

FRAMING.

The side sills are of heavy steel channels, the center sills of heavy I-beams; all longitudinal sills are reinforced on the sides with heavy timbers, as shown in transverse section. The body end sills are channels secured to the side sills by gusset plates and to the center sills by steel castings. The body bolsters are of plates, with a steel draw casting at the center. Under the body end sills are cross trusses, and other cross trusses are provided at the needle beams. Special attention was given to securing strong construction in the floor and roof framing at the ends of the car. The body counterbrace rests at the ends in pocket castings over the bolsters, and brace-rods are secured to the long brace at the joints, passing through the side sills at the needle beams. On each side of the car is a long truss rod with flat ends hooked over the short diagonal braces at the ends of the car. These rods have turnbuckles and extend from end to end of the car. Toward the center of the car the rod is a flat bar, gained into the posts. The ends of the short diagonal braces at the ends of the body counter brace are bored for rods, passing down through the side sills near the bolsters. The truss plank is of Southern pine 1¾ x 11½ ins., extending the full length of the car to the body corner posts in one piece. At the center of the car is a pair of diagonal brace rods secured to the side sllis. The spaces in the bracing below the windows are filled with whitewood blocking.

ROOF FRAMING.

The engravings are intended to illustrate the roof and vestibule construction without detailed description. The principal carlines, of which there are seven, are composite, of wrought iron shaped to the roof and sandwiched between two white ash carlines. White ash is used for the side deck intermediate, upper deck and hood carlines.

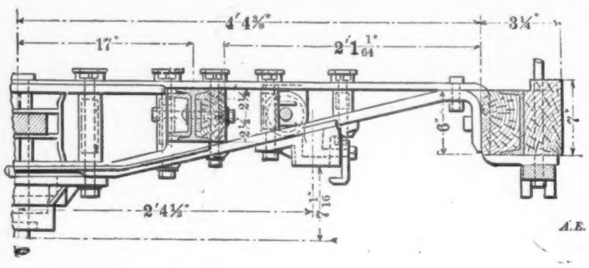
The cars are fitted with guard chains, hand holds and safety gates, everything being designed with a view of allowing the cars to pass the 90-ft. radius curves on the Manhattan tracks, in case the cars should be used on the elevated roads. For this purpose auxiliary bolsters were provided at each end of the cars and extension links are used for transmitting the draw bar pull to the bolsters.

To guard against fire from the wiring the floors are ceiled underneath with ¼-in. "Transite" board secured to all the bridging. The cables are also protected by conduits of the same material, and no wires enter the cars except for lighting and heating. Over the motors the protection is reinforced by steel plate and fire felt. All of these cars have the Gibbs sliding door in the vestibules. The floor is grooved. The cars are sheathed with copper outside and are finished inside with mahogany of light color. The headlining is of composite board.

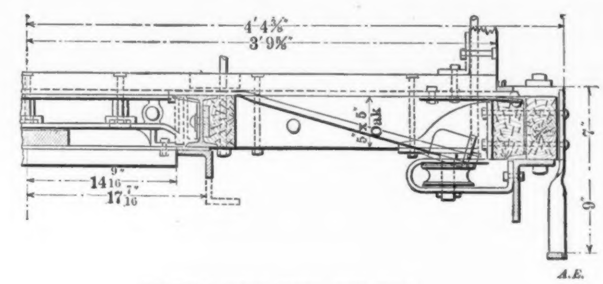
The cars will seat 52 persons. The spaces under longitudinal and cross seats are ceiled up with framework of wood, in which the electric heaters are placed. The interior finish is rather plain, but neat; the panels have marqueterie linings, and all mouldings are plain. The ceiling is of half Empire design, painted light color, with plain decoration. The cars will be lighted with incandescent electric lights, 26 of which are placed on the ceilings inside of the car and two above each platform in the hood. The platform doors are of exceedingly

novel design; the side or exit doors are operated by levers from the end of the car, and the end door is so arranged that when the platform is used as the motorman's compartment this door closes the passageway between the center vestibule-posts, giving the motorman the freedom of the entire platform, and when the door is folded back into the open position it encloses the master control and motorman's brake-valve.

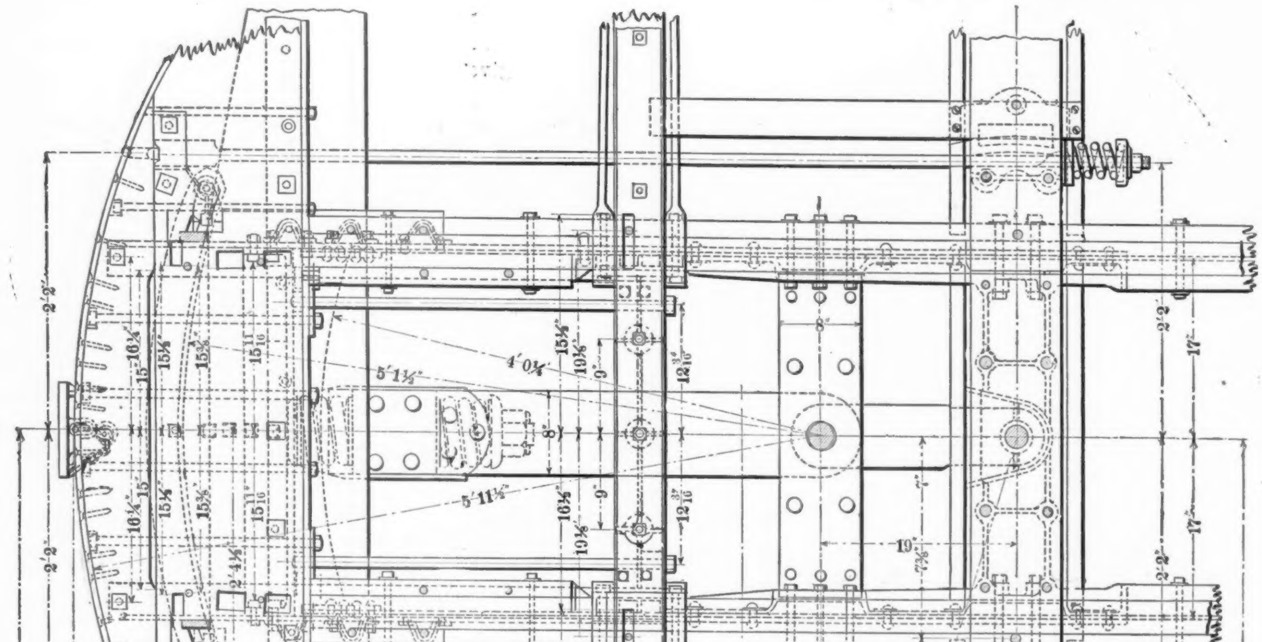
We are indebted to Mr. George Gibbs, consulting engineer, and Mr. W. T. Thompson, master mechanic of the road, for the drawings and information.



BODY BOLSTER.



SECTION NEAR BODY END SILL.



PLATFORM FRAMING AND DRAFT GEAR.

PASSENGER CARS.—INTERBOROUGH RAPID TRANSIT COMPANY.

TEST OF OIL BURNING LOCOMOTIVE.

DISTANCE 1,422 MILES.

ATCHISON, TOPEKA & SANTA FE RAILWAY.

The three-furnace, corrugated firebox, oil-burning locomotive, No. 824, built by the Baldwin Locomotive Works for this road was illustrated on page 10 of this journal for January, 1902. Since the engine went into service the brick setting of the fireboxes has been changed in accordance with the drawing presented herewith.

After the oil-burning devices had been adjusted upon the arrival of the engine at Topeka, it was decided to make a running test with full tonnage in a run of 1,422 miles from Topeka to Needles, Cal., where the engine was to go into regular service. The data were taken by Mr. C. B. Goode, who acted as fireman for the entire trip. Ten engineers served over the various divisions. Oil was carried in a tank car from Topeka and other cars were stationed along the line at Dodge City, Albuquerque and Gallup. The engine tank was filled from the cars by compressed air. Beaumont oil was used over all divisions except the last, from Seligman to Needles, where Bakersfield oil was used. Except between Gallup and Winslow, 128 miles of down grade, full tonnage was hauled all the way. There were no "engine failures" and no trouble whatever except a little difficulty in firing up at one or two points. The boiler was washed out three times on the trip—at La Junta, Raton and Albuquerque. At the other division points the boiler was left full of water over night, and in the morning its own steam was used in firing up.

From Newton to Dodge City the evaporation per pound of oil was lowest. This was because of difficulty in securing the proper adjustment of the two upper burners. In firing oil-burning locomotives the fireman regulates the oil by the color of the smoke at the stack and by the steam gauge. Mr. Goode says: "The only excuses for smoking an oil-burning locomotive are leaky tubes, a leaky firebox or difficulty in adjusting the burners properly." He also says: "Engine 824 has been doing good work on the mountain over a 3½ per cent. maximum grade from San Bernardino to Summit."

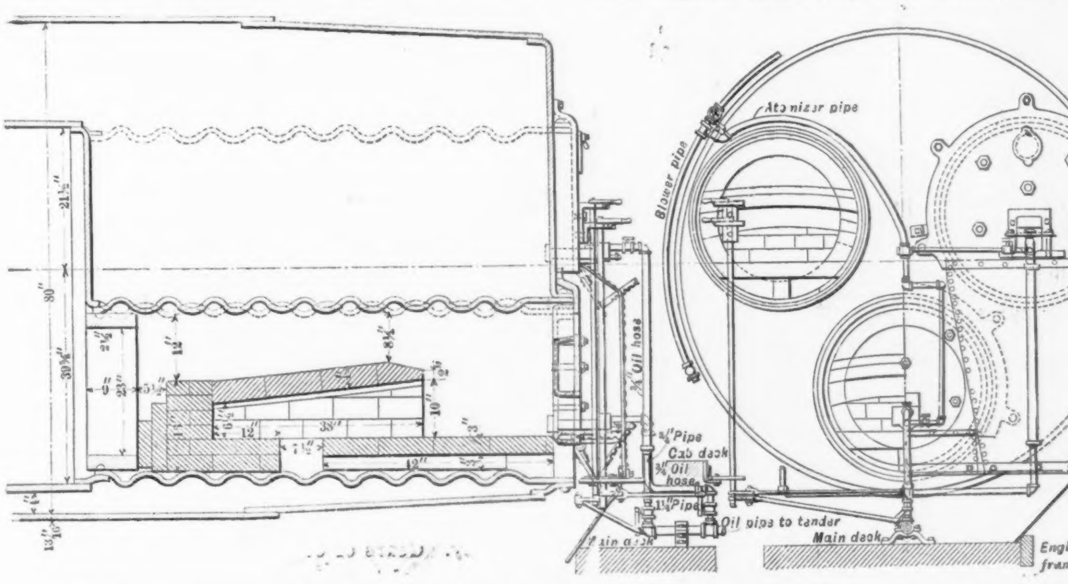
This test does not represent an efficiency investigation of oil fuel, but a running test over a long distance under ordinary road conditions. The data are presented in the accompanying tables. We are indebted to Mr. G. R. Henderson, superintendent of motive power of the Santa Fe, and to Mr. Goode for this information.

OIL AND WATER CONSUMPTION BY ENGINE 824.

Topeka, Kan., to Needles, Ariz., 1,422 Miles.

Left Topeka, May 2, 1902, at 4.40 A. M. Arrived Needles, May 17, 1902, at 1.10 A. M.

Length of time on trip, Topeka to Needles..14 days, 8 hours, 30 minutes
Delays and time not running.............11 days, 1 hour, 35 minutes
Actual running time.....................3 days, 6 hours, 55 minutes
Average speed on trip (running time), miles per hour............18.1
Average tonnage for entire trip ....930 tons
Tons hauled one mile for entire trip ....1,330,631 tons
Total weight oil burned (Topeka to Needles) in tons.........69.9 tons
Total weight water evaporated (Topeka to Needles) in tons..721.6 tons
Water evaporated per lb. oil (Topeka to Needles) in lbs.....10.32 lbs.
Oil burned per ton mile (Topeka to Needles) in lbs............ .105 lb.



FIREBOX SETTING.—LONG-DISTANCE TEST OF A TRIPLE-FURNACE OIL-BURNING LOCOMOTIVE.

ATCHISON, TOPEKA & SANTA FE RAILWAY.

THE RECORD BY DIVISIONS.

Division	Topeka to Emporia	Emporia to Newton	Newton to Dodge City	Dodge City to La Junta	La Junta to Raton	Raton to Las Vegas	Las Vegas to Albuquerque	Albuquerque to Gallup	Gallup to Winslow	Winslow to Seligman	Seligman to Needles
Mileage	62	74	167	202	105	111	132	158	128	143	140
Mean grade—feet per mile	17.2	6.2	7.9	9.	36.4	17.6	17.1	16.	2.	25.	10.
Date	5-2-02	5-2-02	5-3-02	5-4-02	5-6-02	5-8-02	5-9-02	5-11-02	5-11-02	5-14-02	5-16-02
Train No.	29	Extra	3d-33	Extra	1st-33	Local	1st-33	1st-33	Extra	Extra	Extra
Leaving time	4.40 a.m.	5.45 p.m.	6.05 p.m.	11.30 a.m.	11.25 a.m.	9.15 a.m.	11.35 a.m.	4.25 a.m.	8.15 p.m.	7.45 a.m.	4.30 a.m.
Arriving time	9.40 a.m.	1.05 a.m.	3.50 a.m.	5.30 a.m.	8.05 p.m.	12.45 a.m.	9.45 p.m.	5.25 p.m.	3.50 a.m.	8.05 p.m.	1.10 a.m.
Time on road	5 h.	7 h., 20 m.	9 h., 45 m.	18 h.	8 h., 40 m.	15 h, 30 m	10 h, 10 m	13 h.	7 h., 35 m.	12 h, 20 m	8 h., 40 m.
Actual running time	3 h., 50 m.	4 h., 50 m.	7 h., 40 m.	11 h, 20 m	5 h., 50 m.	7 h., 10 m.	6 h., 55 m.	9 h., 40 m.	5 h.	9 h.	7 h., 40 m.
Average speed—miles p. h.	16.2	15.3	21.8	17.8	18.	15.5	19.1	16.4	25.6	15.9	18.3
Tonnage	1,100	2 000	1,273	1,110	545	1,125	635	1,000	25	1,030	700
Number of cars	....	72	....	70	....	42	39	38	1	25	....
Tons hauled one mile	68,200	148,000	212.591	224,220	56,135	124,875	83,820	158,000	3,200	147,290	104,300
Oil burned over division, lbs. (actual)	9,177	11,362	14,044	21,850	10,925	11,799	10,488	17,480	4,807	17,480	10,488
Water evaporated over division, lbs. (actual)	88,096	110,070	127,314	202,515	125,495	133,916	109,495	202,102	54,963	199,692	109,568
Evaporation per lb. oil, lbs.	9.60	9.68	9.06	9.27	11.50	9,66	10.44	11.53	11.43	11.42	10.45
Oil burned per ton mile, lbs.	.134	.078	.066	.098	.194	.094	.125	.110	.150	.102	.101
Oil burned per engine mile, lbs.	148.	154.	84.	108.	104.	106.	79.	111.	38.	122.	70.

MACHINE TOOL PROGRESS.

III.

FEEDS AND DRIVES.

BY C. W. OBERT.

A PORTABLE POSITIVE FEEDING ATTACHMENT.

The preceding articles of this series have dealt with types of variable-speed positive-drive feeding mechanisms which have been built upon machine tools as an essential part, being incorporated in the design of the machine and thus not applicable to any other tool. The National Machine Tool Company, Cincinnati, Ohio, have introduced an independent feeding mechanism, which is of particular interest because it will accomplish the same purpose, yet at the same time is a complete and separate attachment in itself, which is applicable to any lathe equipped with the usual style of quadrant for change gears. It is quickly applied to a lathe and easily manipulated, and will prove invaluable where it is desired to replace the loose change gear system and belt feeds by positive-drive geared feeds in adapting a lathe to the new high-duty tool steels for hard use and profit making.

The accompanying engravings on the opposite page present comprehensive illustrations, front, rear and internal, of this interesting device. It consists of a series of pinions of different sizes mounted within a dust proof case and arranged to all rotate together in mesh with a common intermediate gear, and means of delivering motion from any of the driven pinions through various gear combinations. Fig. 15 shows the arrangement of the nine pinions, E-E, around the common driving gear, F, the front half, M, of the case being removed. The common gear, F, is mounted upon and rotates on the eccentrically located stud, R, on the front half of the frame; it is to be noted that gear, F, is not driven at its hub.

The device is mounted upon a lathe by merely bolting the mounting plate, P, to the lathe's quadrant in place of the intermediate gear, and so adjusting it that the receiving gear, A, may be swung into mesh with the spindle pinion, S. As may be seen in Fig. 15, gear, A, is mounted upon a bracket, J, adjustable concentrically with gear, B, which is driven by A; this facilitates the proper meshing of the gears and also renders the device adaptable to lathes of different designs.

The drive for the gearing is from the spindle pinion, S, of the lathe through gear, A, to gear, B, which is mounted upon a shaft passing through the extension hub, O, of bracket, J, upon which the frame of the gear box is mounted by the hole in stud, R. The opposite end of this shaft is keyed for the driving gear, C, Fig. 13; gear, C, drives the train of gears within the case by means of pinion, D, which may be mounted at will upon either one of two of their extended shafts, 2 or 3, which project out through the front of the case, and are feathered and provided with spring buttons for retaining the gear. As may be seen from the internal view, shaft 3 drives gear, F, at a slower rate, while shaft 2 will drive it at a faster rate; thus, by means of pinion, D, two rates of speed are available, while inasmuch as gears, C and D, are entirely interchangeable four changes of speed may be obtained.

The method of taking motion from any one of the pinions, E, which run at differing speeds in mesh with common gear, F, is by means of jaw clutches, H-H, in the ends of their shafts projecting through the rear half, N, of the case, Fig. 14. Delivery gear, G, may be thrown into connection with any one of those clutches by either one of the corresponding clutches, 5 or 6, which are controlled by knob, K. The case of the gear box may be rotated upon its center bearing, O, after being released by handle, L, in order to bring any one of clutches, H, into line with either 5 or 6.

The purpose of the two clutches, 5 and 6, is for reversal of feeds; when 6 is thrown in and drives feed gear, T, direct, it delivers motion in the same direction in which gear, C, and the spindle of the lathe are rotating, while if 5 is thrown in clutch, feed gear, T, is driven in an opposite direction from that of the lathe's spindle, the reversal of motion being due to the pinion on shaft, 5, driving through pinion, G, as an idler or intermediate. Thus by throwing shaft, 5, into clutch, which is done by turning knob, K, to the left, the carriage of the lathe is given right-hand travel, while throwing in clutch, 6, by turning K to the right gives the carriage left-hand travel.

The proper positions of the case for clutching the various pinions are indicated by marks upon the outer edge, which are brought around to pointer, X, for clutch 5, or to pointer, Y, for clutch 6. The jaw clutches, H-H, and on 5 and 6, are of steel thoroughly hardened so as to be thrown in clutch while the lathe is in motion with perfect safety.

As may be noted in Fig. 15, the stud, R, was located eccentrically upon M in order to allow the larger sizes of the nine pinions, E-E, to be placed all at one side of the common gear, F, and thus permit of a smaller case. The revolving of the case for bringing any of the clutches into line for connecting up is very easily accomplished after releasing the clamping lever, L, by using the hub of gear, D, as a handle, while the proper clutch to use for any particular thread to be cut on the lathe is indicated by the table of gear combinations located on the frame beside knob, K. For the entire range of thread cutting it is only necessary to change gear, D, on the front of the box, twice, all other necessary changes being made by rotating the gear casing and operating the clutches. The drive is always through only two gears in the casing, and the common intermediate, which has its bearing on the long hub, O, within the casing.

For general purposes the thirty regular changes possible are sufficient. On the No. 4 attachment they cover the following threads per inch: 4, 5, 6, 7, 8, 9, 10, 11, 11½, 12, 13, 14, 16, 18, 20, 22, 24, 26, 27, 28, 30, 32, 36, 40, 42, 44, 46, 48, 52 and 56, while the feeds are in proportion. This range is obtained by driving, if the lathe has four threads per inch on the lead screw, from a 36-tooth gear on the spindle or stud to a 48-tooth gear on the lead screw. If a 24-tooth gear is substituted on the screw, one-half the index, or from 2 to 28 threads per inch, can be cut, and coarser feeds obtained. The contrary is also true, of course, and by making the reduction in the size of the driving gear the series will comprise a range of finer threads and feeds. This may be carried out indefinitely. Gears of other proportions are used accordingly as the number of threads per inch on the lead screw may vary; as, for instance, for metric threads a 50-127 pair of gears is used.

The following table gives the gears to be used in driving for the different sizes of feeding attachments. Other gears with the same ratios may, of course, be used:

Size of Attachment.	Spindle or Stud Gear.	Screw Gear.	Pitch of Screw.
No. 3.	24	54	4
	30	54	5
	36	54	6
No. 4.	24	48	4
	30	48	5
	36	48	6
No. 5.	48	48	4
	60	48	5
	72	48	6

Fig. 16 is an illustration of the Schellenbach feeding attachment applied to an engine lathe made by the Bradford Machine Tool Company, of Cincinnati, Ohio. This device is unquestionably a very valuable one and has proven very serviceable, being applicable, as it is, to any lathe. It is of very compact design and is easily handled. It will be of inestimable value in the great task of displacing the old method of belt feeding, with its many objectionable features.

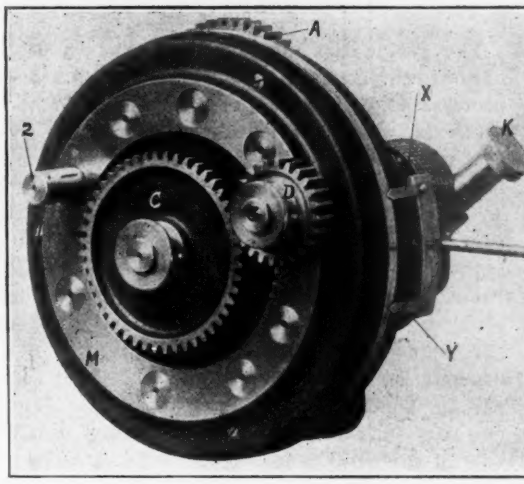


FIG. 13.—GENERAL VIEW OF THE SCHELLENBACH FEEDING ATTACHMENT.

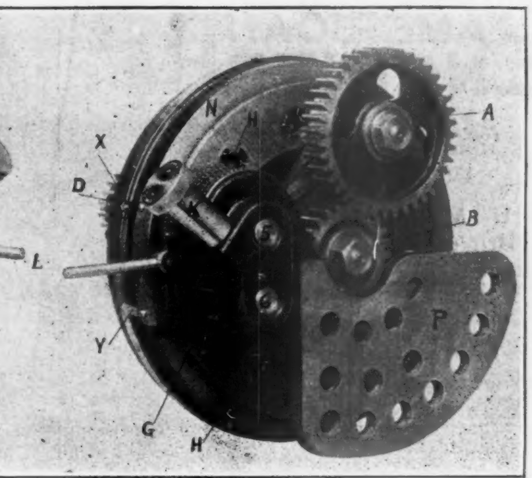


FIG. 14.—REAR VIEW OF FEEDING ATTACHMENT, SHOWING SUPPORTING PLATE.

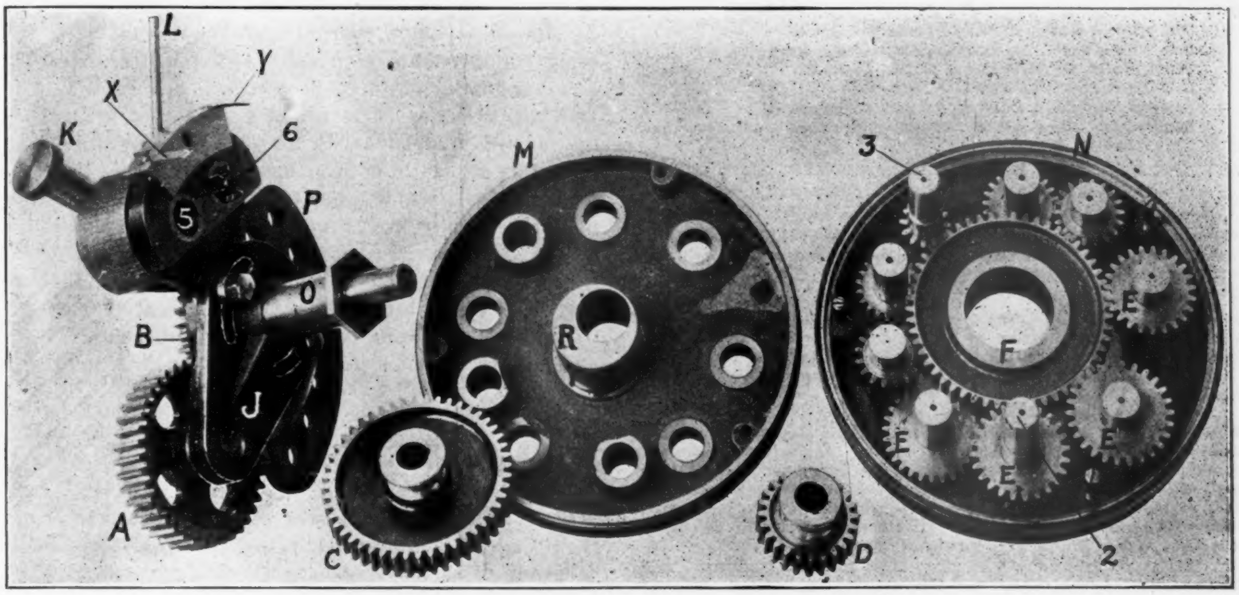


FIG. 15.—INTERNAL VIEW OF FEEDING ATTACHMENT, SHOWING ARRANGEMENT OF THE COMMON INTERMEDIATE GEAR AND MULTI-SPEED PINIONS.

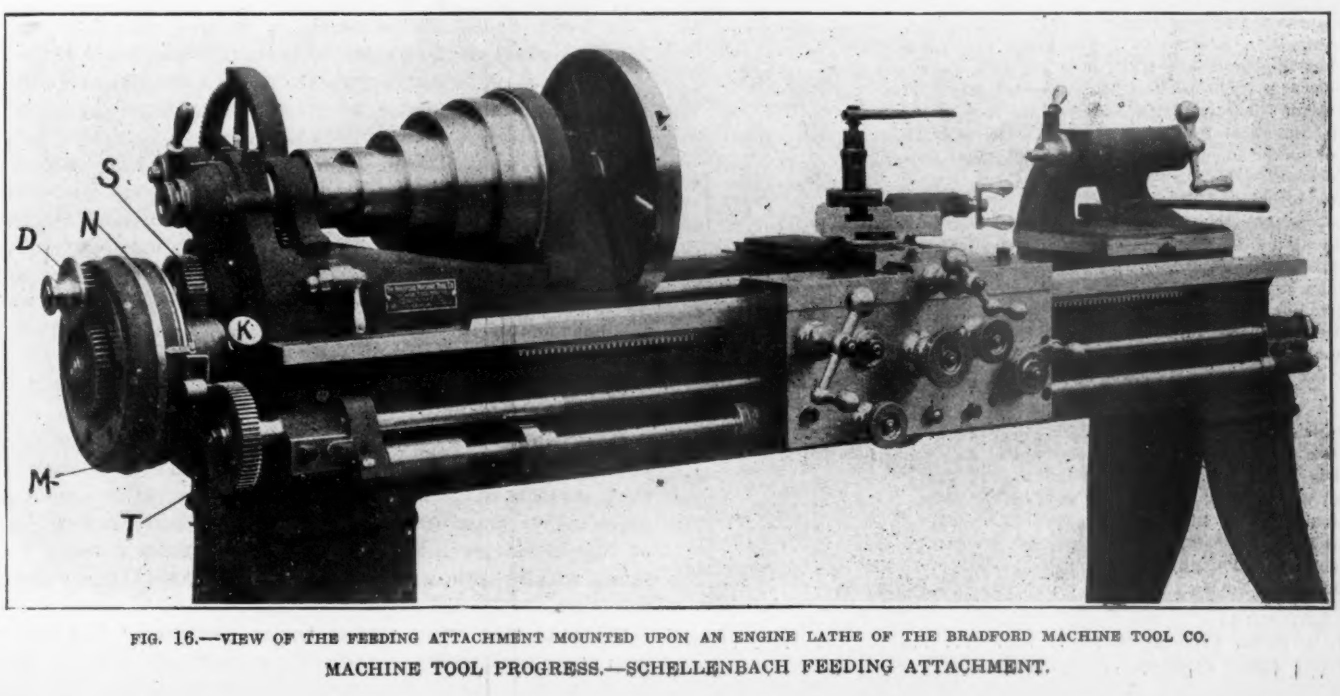


FIG. 16.—VIEW OF THE FEEDING ATTACHMENT MOUNTED UPON AN ENGINE LATHE OF THE BRADFORD MACHINE TOOL CO.

MACHINE TOOL PROGRESS.—SCHELLENBACH FEEDING ATTACHMENT.

(Established 1832.)

AMERICAN ENGINEER AND RAILROAD JOURNAL

PUBLISHED MONTHLY
BY
R. M. VAN ARSDALE,
J. S. BONSALL, Business Manager.

140 NASSAU STREET.......................................NEW YORK

G. M. BASFORD, Editor.

C. W. OBERT, Associate Editor.

MARCH, 1903.

Subscription.—$2.00 *a year for the United States and Canada;* $2.50 *a year to Foreign Countries embraced in the Universal Postal Union.*
Remit by Express Money Order, Draft or Post Office Order.
Subscriptions for this paper will be received and copies kept for sale by the
Post Office News Co., 217 Dearborn St., Chicago, Ill.
Damrell & Upham, 283 Washington St., Boston, Mass.
Philip Roeder, 307 North Fourth St., St. Louis, Mo.
R. S. Davis & Co., 346 Fifth Ave., Pittsburg, Pa.
Century News Co., 6 Third St. S., Minneapolis, Minn.
Sampson Low, Marston & Co., Limited, St. Dunstan's House, Fetter Lane, E. C., London, England.

EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* AMERICAN ENGINEER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.* **When a subscriber changes his address** *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

CONTENTS.

ARTICLES ILLUSTRATED: Page
American Engineer Tests.......... 82
Locomotive, New 4—6—2 Passenger, Chicago & Alton.......... 85
Shop Improvements, M. C. R. R., at Jackson, Power Plant.......... 88
Subway Cars, New York, Interborough Rapid Transit Company.... 95
Test of Oil-Burning Locomotive, A., T. & S. F.......... 97
Machine Tool Progress, Feeds and Drives.......... 98
Collinwood Shops, L. S. & M. S., Individual Drives.......... 102
Locomotive, New 2—8—0 Freight, C., R. I. & P. Ry.......... 106
Counterbalance, The Davis.......... 108
Locomotive, New 2—8—2 Compound Freight, A., T. & S. F.......... 109
Machining Performance, Motor-Driven Boring Mill.......... 110
Reading Shops, P. & R. Ry., Boiler Shop.......... 114
Suburban Locomotive, Powerful English.......... 115
Grinding Machine, Portable, Electrically Driven.......... 116
Drawing Table for Tracing Blue Prints.......... 116
Dunbar Packing Rings, Device for Spacing.......... 118
Wood Planer and Matcher, S. A. Woods Machine Company.......... 118

ARTICLES NOT ILLUSTRATED:
Railway Shops, by R. H. Soule.......... 81
Time Element, Influence on Mechanical and Transportation Matters 83
"Big Engines," What They Mean.......... 84
Correspondence: "Influence of Time Element".......... 108
Atomizers for Liquid Fuel.......... 115
Grading of Waste, "Merit Marking" System.......... 117
Books and Pamphlets.......... 119
Industrial Notes 120

EDITORIALS:
H. G. Prout, Personal Notice.......... 100
Motive Power Salaries.......... 100

H. G. PROUT.

The resignation of Colonel Prout after sixteen years as editor-in-chief of the *Railroad Gazette* is a distinct loss to the profession of technical journalism. To the Westinghouse interests, whose service he enters as vice-president and general manager of the Union Switch and Signal Company, there is a corresponding gain, and thus another general officer with an international reputation is secured to the staff presided over by Mr. George Westinghouse, again testifying to his ability to surround himself with the ablest men. Colonel Prout combines natural ability, attractive and polished personal traits, general information and a broad minded manner of dealing with large questions, in a way which has brought him distinction as an engineer, both at home and abroad, honor as a man and a position of great respect and powerful influence as an editor. His experience includes service in the Civil War, education as an engineer, commissions of responsibility in the Soudan, where he was an assistant and associate of General Gordon, commercial business in New York and his long and successful editorial charge of the *Railroad Gazette*. His name takes a worthy place with those of Messrs. Dunning, Forney and Wellington. He has effectively employed his ability to write and to speak in public and has placed his high professional and personal ideals before many bodies of men and engineering students through his lectures and addresses as well as his writings. He has served as an educator to prospective engineers in the problem of facing the world and has furnished them an inspiring example. He has also been prominent in the most important work of the American Society of Civil Engineers. His hosts of friends cannot wish him more success in the future than has always attended him. It is regretted that Colonel Prout retires from the leading position in this profession, the standard and dignity of which he has done so much to improve.

THE MATTER OF MOTIVE POWER SALARIES.

If all of the motive power superintendents in the country should resign simultaneously to-day the managements of the railroads would have at least three surprises.

The motive power department would be discovered to be most important and most neglected, from a business point of view.

It would be found impossible to secure the right men to fill the positions immediately, as these men are not in training.

The heads of these departments would be in demand among industrial establishments at from two to three times their present salaries.

It would be a blessing to the railroads to have this very thing happen. It would reveal a state of weakness which the real owners of the properties need to understand. They need to know that most railroads do not for a moment consider promotion from the staff to fill the position of the chief; that these officers are not as a rule encouraged to pursue a business policy in their departments and that the position of superintendent of motive power demands a grade of ability and a fund of experience which are sought for and paid for appropriately by the "captains of industry."

How simple are the specifications for the men who would be so greatly needed! They must be masters of men and thorough students of the labor problem. They must be able engineers. They must be business men. They must be organizers of campaigns far more complicated and more difficult than those which have won the praise of nations for military successes.

Granting that every motive power department has such a man at its head to-day—what about the future? What is there

about the present situation to attract and stimulate the ambition of the best mechanical talent of the times to prepare for these responsibilities and truly great opportunities? These questions need attention, and they need it now.

Because of its source and its clear expression the following letter to the editor from a successful superintendent of motive power, now retired from railroad service, is presented here, and it needs no comment:

"I have been quite impressed by the article on the editorial page of your January number, on the subject of inadequate pay of motive power officers in the United States. I think you state the proposition fairly, and it exactly fits the conditions which many have experienced in this line of work. I venture to state that many a mechanical officer in his reflections upon the 'state of things' has seen pictured in his mind, 'He who enters here leaves all hope behind.' If not in exact phrase, he has seen it at least in substance.

"I remember, a good many years ago, while hanging over a drawing board, of being advised by my professor to the effect that if I did that work well to be sure to let no one know it, as I would certainly be kept at it. I feel that the mechanical department has been 'kept at it' so long as a result of the present system that there is a great dearth of suitable men to fill the positions now being offered.

"Many a chief clerk in the mechanical department has gone around and up, due to the needs of some other department, while the 'boss' is pulling, discontentedly, at the end of his rope. It would seem almost a waste of money for a young man to attempt to fit himself for a mechanical position on some of the American railroads, as he could do just as well in some other department, given the same amount of sense, without going through a technical school.

"The mechanical officers have done well, as the shops and equipment show in many cases, when we consider how subordinate the department is on some lines. I know of a recent case where a motive power superintendency on a road having about 700 engines was offered at $5,000, and possibly 'might' pay $6,000 per year. The position is a hard one, labor conditions most difficult and the intelligent advice needed for dependent lines an indefinite quantity. I believe, however, no mention was made in this case of a 'tenor voice' among the requisites. What a prize to draw!

"As you have said, ' the gates to higher positions must be thrown open.' This will not be done by those most immediately superior to the mechanical department by relinquishing voluntarily the authority which they have so long enjoyed. It must come from the top and the mechanical department must be brought into 'close harmony' with the highest officials and recognized as a necessary and prime part of the organization instead of a nuisance of secondary importance—to be just tolerated. I know of railroads on which the effort to keep the mechanical department in the background is not often lost sight of and would be almost comical, if it were not for the uncomfortable position which the department occupies.

"I remember, some years ago, meeting Mr. Worsdell, mechanical superintendent of the North Eastern Railway, in York, England. He said that he would be pleased to be of service to me as soon as a certain meeting of the directors which he was in York to attend was over. While I do not suppose such a condition as motive power officials being asked to meet the board of directors is likely to become common in the United States, nevertheless this incident speaks volumes as to what the relation between the mechanical and the other departments should be.

"It cannot be contended that all mechanical departments are properly run or that every man who happens to be head of a mechanical department is a genius, but the mechanical department is a vital element in railroad organization and should be so recognized. A competent and trusted man with sufficient compensation should be put at its head, one who will not look upon the future as hopeless on account of the existence of a bar to his advancement. Some railroads have done this. I hope more will follow. I feel that I may speak to you on this subject, as I am not a candidate for the good things which may open to the mechanical department—'some day'."

With cars accumulating upon so many sidetracks for want of locomotives to move them, the suggestion of Mr. Herbert T. Herr in his article on page 83 of this number is opportune. If the only recognition of the time element in freight service, so far as the crews are concerned, is the payment of "overtime," there is not only no incentive for prompt and efficient work, but rather a premium upon the opposite of these.

Mr. Herr suggests placing a premium upon acceleration of train movements and in a way which seems likely to bring out a concerted effort of enginemen, trainmen and dispatchers to accomplish it. Train service is a complicated one, involving many elements and presenting many difficulties in the way of a general improvement like this one, but the proposed method seems worthy not only of discussion but of actual trial. It will, of course, be necessary to pay overtime for delayed crews, but there seems to be no objection to paying an equal or a higher premium for getting in on time. It is reasonable to suppose that such a plan would result in a large reduction in the time lost by a few minutes here and there, which amounts to many hours in the course of a month and on a long division.

This suggestion involves the principle of "piecework" in securing the maximum output of machinery. It would undoubtedly have the same effect on the road as in the shop, and its application to train service cannot be more difficult than in building or repairing locomotives and cars. It would seem to be much easier to apply to trains. It will be interesting to know what the readers think of this.

The voluntary loyal support of workmen is needed in order to secure the desired results from them. This cannot be had in any shop unless a tradition of fair treatment exists, and neither piece-work nor anything like it can succeed in the absence of such a tradition. The unwritten law of business must begin at the top. "One-man power" of the right sort will accomplish this result. Mr. J. F. Deems has said: "I believe the power that succeeds is the one-man power where the one man, by his example, by his tact, by his judgment, by his sense of justice and right, by his love for his fellow men and of the business he is engaged in, by his enthusiasm and personal magnetism, controls and leads the hundreds and thousands of other men without their knowing it."

The question is, How can men be brought into the frame of mind which makes them a part of the company instead of being mere servants?

A division superintendent was complaining about the delay to through freight trains in a yard for inspection. This suggested to the superintendent of motive power the possibility that the inspection at that point was unnecessarily rigid, and it was decided to have the trains looked over for safety on arrival and the brakes set by the engine hauling the train into the yard. If the next engine, when coupled on to haul the train out on its further journey, is able to release all the brakes the train proceeds at once. Cars which will not release have their brakes cut out and are carded, but the train goes on and such cars are set out for repairs at the first convenient point. This works well and saves a lot of time.

The importance of counteracting the momentum of rapidly moving parts of reciprocating machine tools is only beginning to be realized. Considerable attention was given to this at the Collinwood shops, several of the motor-driven planers, shapers and slotters having been equipped with flywheels to overcome the inertia effects in reversing. This is discussed on pages 102-103.

NEW LOCOMOTIVE AND CAR SHOPS.

COLLINWOOD, OHIO.

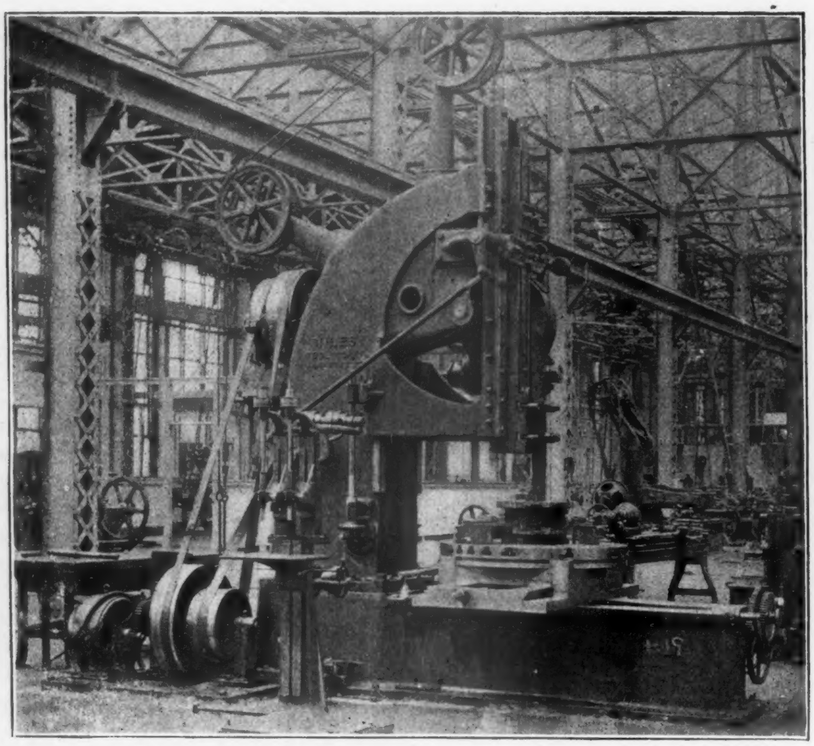
LAKE SHORE & MICHIGAN SOUTHERN RAILWAY.

VI.

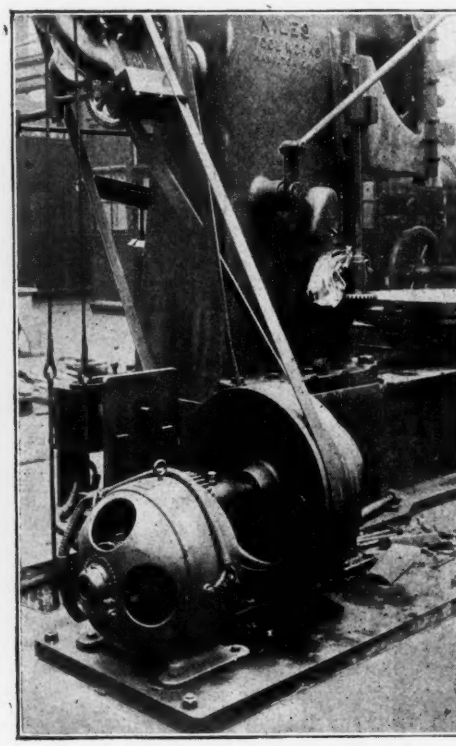
INDIVIDUALLY DRIVEN MACHINE TOOLS.

A NEW APPLICATION OF THE PRINCIPLE OF MOMENTUM IN DRIVING RECIPROCATING TOOLS.

One of the most difficult problems met in the applications of motors for the individual driving of the machine tools at the Collinwood shops was that involved in the driving of reciprocating machines, such as planers, slotters and shapers. Most of such tools are provided with quick return motions of the table or ram, and it is a well-known fact that such reversals,



24-IN. GEARED SLOTTING MACHINE.—NILES TOOL WORKS CO.
SPECIAL FLYWHEEL DRIVE FROM A 7½-H.P. MULTIPLE-VOLTAGE CROCKER-WHEELER MOTOR.



DETAIL VIEW OF MOTOR AND FLYWHEEL.

COLLINWOOD SHOPS.—LAKE SHORE & MICHIGAN SOUTHERN RAILWAY.

in all cases, bring very heavy instantaneous demands for power. Upon tools of this type this results in bringing, at intervals, heavy surges of current into the motor—in fact, so heavy that the overload-release circuit-breaker protecting the motor must necessarily be set for a current several times greater than that normally required.

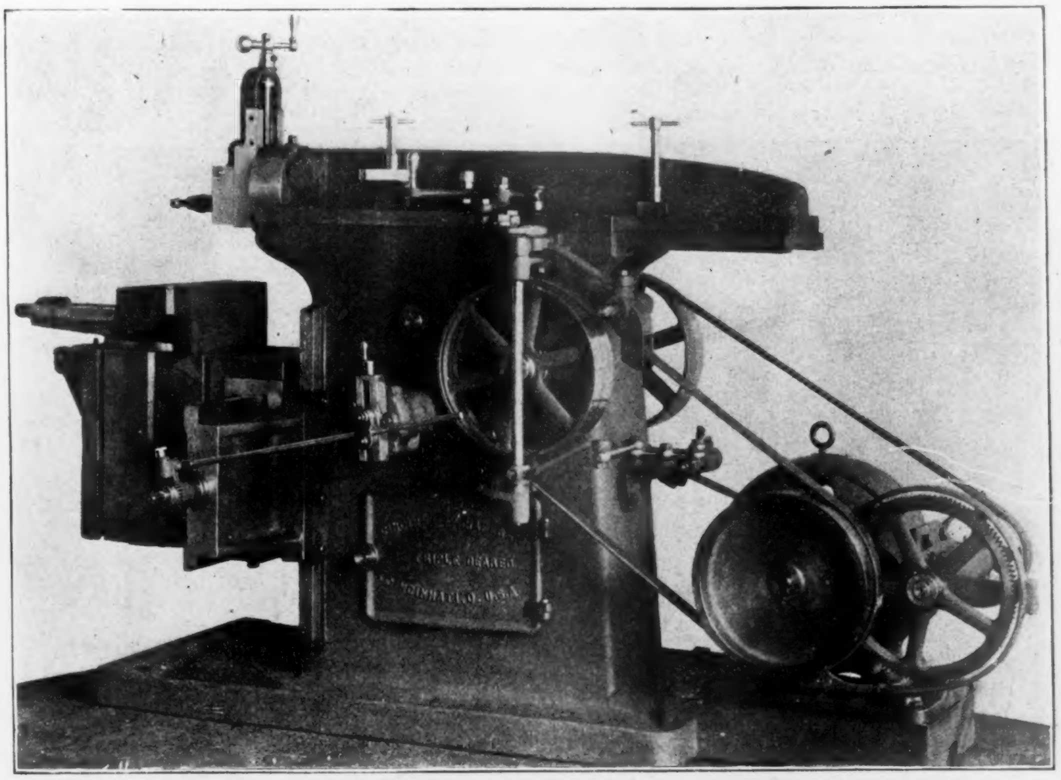
Actual power input tests that have been made upon motor-driven planers have shown that a Niles 10-ft. x 10-ft. x 20-ft. planer, machining cast iron with three cutting tools and requiring 26-h.p. at the motor on the cutting stroke, brought a demand for 43-h.p at the instant of reversal, while only 24-h.p. were required for the balance of the quick return stroke at a speed of three times that of the forward stroke. An 8-ft. x 8-ft. x 20-ft. Pond motor-driven planer, which required 15-h.p. on the cutting stroke while machining cast iron, demanded a surge of current amounting to 29 h. p. at the instant of reversal of the platen, while the remainder of the 3 to 1 quick return stroke was made with only 14-h.p.

An extreme case of this kind was developed at the works of the William R. Trigg Company, Richmond, Va., in an attempt to drive direct, by a 15-h.p. Crocker-Wheeler multiple voltage motor, a 36-in. planer which was geared up for a cutting speed of 30-ft. per min. and a reversal speed of 75-ft. per min. Power input tests showed that the average power required for the cutting stroke was only 8-h.p, while at the instant of reversal an extreme demand for current was made amounting to over 40-h.p.—a momentary overload of 250 per cent.; a reduction of the platen speeds of the machine by one-half, from 30 and 75 ft. per min. down to 15 and 37½ ft. per min. resulted in bringing the overloading down more than one-half, within the overload limit of the motor. These figures show very plainly that it is not the quick return motion of the table that causes the extra demand for power, but rather that the surge of power is required in overcoming the inertia of the moving parts in forward motion, including the platen and the rapidly revolving pulleys, for the reversal.

It is the opinion of a great many that this heavy inertia effect originates in the rapidly moving pulleys used in connection with the reversing mechanism rather than in the movement of the planer's platen, so that if the pulleys used in the drive be made as light as possible and a heavy fly-wheel be used on the motor's shaft the inertia will be reduced somewhat and partially prevented from taking effect upon the motor. Experiments made in this direction show that a decided gain is effected by such an application of a fly-wheel to the motor's shaft, so as to assist with its stored energy of rotation in supplying the demand made for power at the instant of reversal. On a 60 x 60-in. x 12-ft. Pond motor-driven planer it was found that, by mounting a 42-in., 1500-lb. fly-wheel on the motor's shaft which ran at 400 rev. per min., the power demanded at the instant of reversal of the platen was only 2-h.p. greater than that required for the quick return, which was 14-h.p., the power required during the cutting stroke being 10-h.p. In another case a 30-in. fly-wheel, weighing 500 lbs., was applied to the shaft of a motor which ran at 800 rev. per min., driving a 28 x 32-in. x 6-ft. Gray planer, and the power demanded at the instant of reversal of the platen was found to be only 4.5-h.p., the power required for the cutting stroke

being 3.2-h.p. and that for the quick return stroke being 3.9-h.p. Also a fly-wheel has been applied to the motor driving the above-mentioned 36-in. planer at the Trigg Company's shops with equally successful results for the reversals.

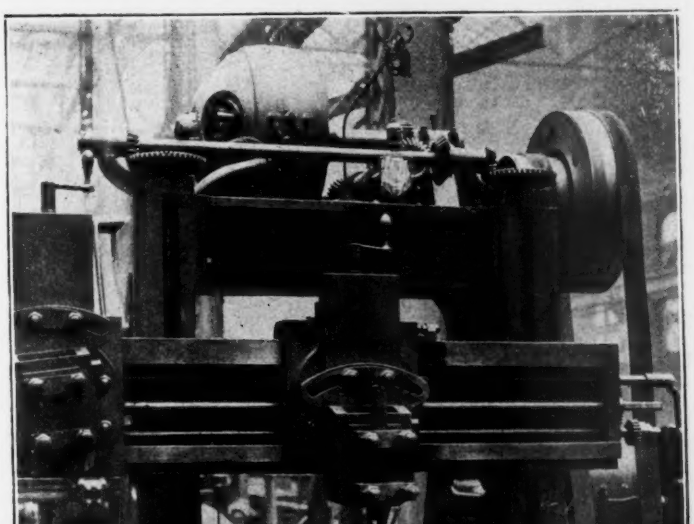
In the Collinwood shops installation the question of fly-wheels received particular attention, several of the reciprocating machines being equipped with fly-wheels at the motors, and several machines of this type have been thus equipped since their installation. On page 102 is an illustration of the 24-in. Niles geared slotting machine which has a fly-wheel as an auxiliary to the motor. The detail view at the right gives an idea of the method of applying the fly-wheel; it is mounted upon a shaft which is driven by the motor through a reduction gearing, the latter shaft serving as the drive for the machine. The application of this wheel presented no interference with the regular drive of the machine inasmuch as the fly-wheel is used as the belt wheel for the quick return motion of the ram.



26-INCH TRIPLE-GEARED RACK SHAPER.—CINCINNATI SHAPER CO.. SPECIAL FLYWHEEL DRIVE FROM A 3-H.P. CONSTANT-SPEED CROCKER-WHEELER MOTOR.

One of the most interesting of the fly-wheel drives is that on the 26-in. triple-geared shaper, shown herewith, which was built and equipped with the fly-wheel drive by the Cincinnati Shaper Company, Cincinnati, Ohio. The motor, which is of the back-geared type, is mounted on an extension of the machine's bed, the drive being by the usual shifting belts direct to the driving pulleys. A heavy fly-wheel is mounted direct upon the extended armature shaft and is utilized as the belt wheel for the quick return motion, while the forward motion for the cutting stroke is obtained through the single reduction gearing. This method is simple and avoids any mechanism other than would be required for a countershaft and belt drive—indeed it is difficult to imagine a more direct method of accomplishing the result desired in this case.

The engraving at the left presents a view of the 36-in. Pond planer which was formerly driven from the motor through an ordinary spoked belt wheel, but has since been equipped for the fly-wheel effect by the bolting in of circular-shaped weights within the rim on each side of the spokes. In this manner the desired result was accomplished without disturbance to the machine. The 54-in. Pond motor-driven planer, illustrated in the lower view upon page 104 presents another example of the fly-wheel driven reciprocating tool. In both of the latter planer cases the fly-wheel is not mounted upon the shaft of the motor, but upon an intermediate shaft which is driven from the motor through reduction gearing.



36-IN. X 36-IN. X 10-FT. PLANER.—POND MACHINE TOOL CO. SPECIAL FLY-WHEEL DRIVE FROM A 7½-H.P. MULTIPLE-VOLTAGE CROCKER-WHEELER MOTOR.

COLLINWOOD SHOPS.—LAKE SHORE & MICHIGAN SOUTHERN RAILWAY.

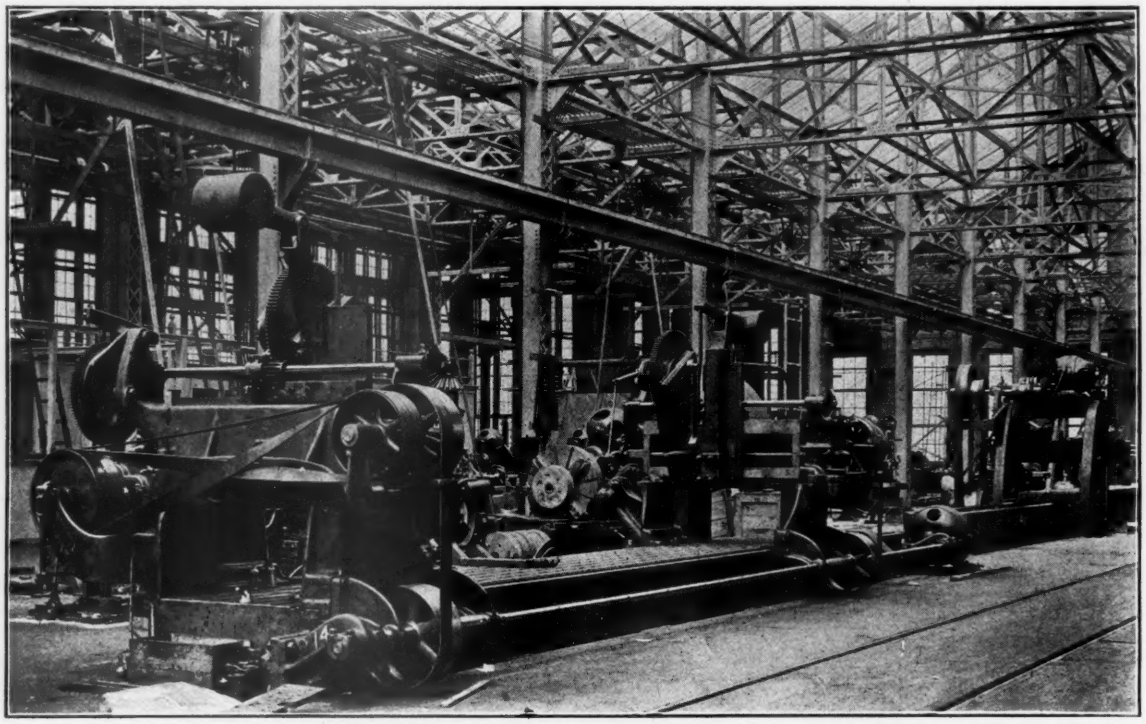
THE MACHINE TOOLS.

The accompanying illustrations of the machine tools present further representative examples of the motor-driving equipments installed at Collinwood, in addition to those illustrated in the preceding article of this series. The motor mounting is shown on all of the machines, but in many cases it was found impossible to so choose the views as to show the electrical controlling apparatus, on account of their being located on opposite sides of the tool.

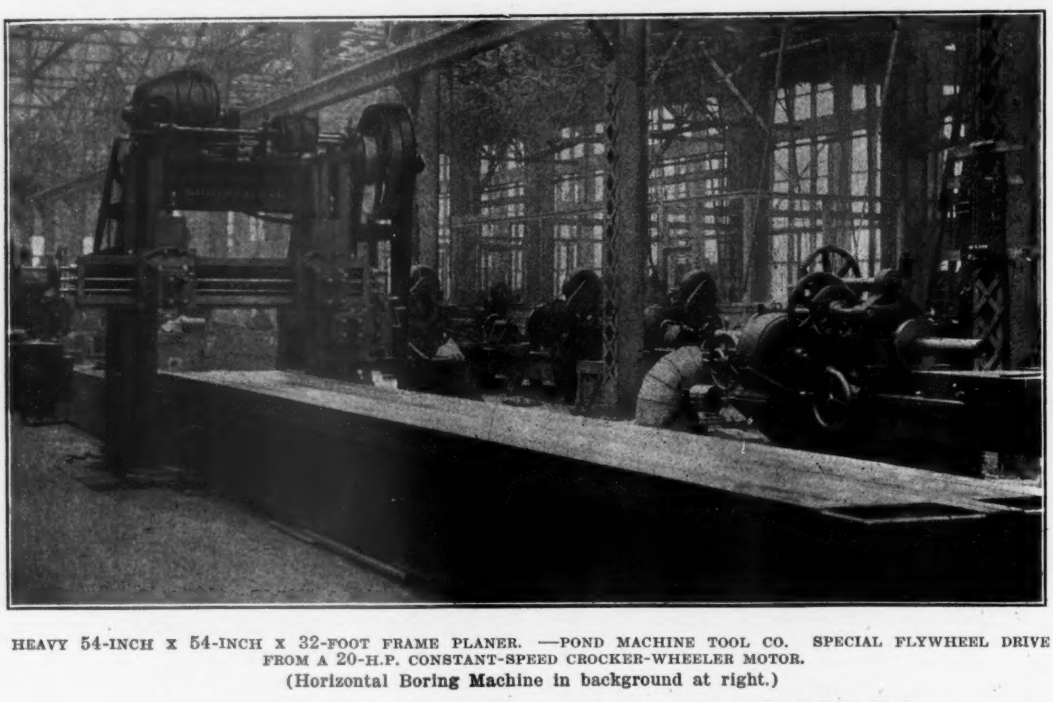
The slotting machine illustrated on page 102 is the 24-in. geared slotter (tool No. 19) made by the Niles Tool Works Company, and is driven by a 7½-h.p. Crocker-Wheeler multiple-voltage motor. The motor mounting is independent of the tool, being located upon a separate base upon the floor, and the controlling switches, starter, etc., are conveniently located for the operator on the opposite side of the tool. This slotter is

geared for heavy forge work, the ram being driven by rack and pinion, with tangent gearing at the side. The circular table is 50 ins. in diameter and has 40 ins. longitudinal feed and 36 ins. cross feed, the feeds always taking place at the top of the ram's stroke.

The motor-driven shaper illustrated on page 103 is a 26-in. triple-geared shaper of the rack type (tool No. 82) made by the Cincinnati Shaper Company, Cincinnati, Ohio, the motor used for driving it being a 3-h.p. constant-speed Crocker-Wheeler motor. As regularly built for belt drive, the pulleys for the forward and return motions of the ram are placed on the front side of machine; but in order to have the same relative pulley speeds with motor drive as given by belts, the pulley for the reverse or backing motion of ram is placed on front side of the machine, and is driven directly from the fly-wheel on the armature shaft, and the pulley for the cutting or forward motion of the ram is placed at the back and is driven by a pulley on a back shaft, the bearings for which are bolted to the motor frame. The gear on the back shaft runs in mesh with a rawhide pinion attached to the armature shaft, the ratio between the gears and the driving pulleys being such as to give the proper relation between the cutting and reverse speeds of the ram. The design of this shaper involves many interesting features. The head swivels to any angle, being graduated, and is pro-



DOUBLE HEAD LOCOMOTIVE FRAME SLOTTING MACHINE.—BEMENT, MILES & CO. DRIVEN BY A 20-H.P. MULTIPLE-VOLTAGE CROCKER-WHEELER MOTOR.
(Heavy 54-inch Frame Planer in background at right.)

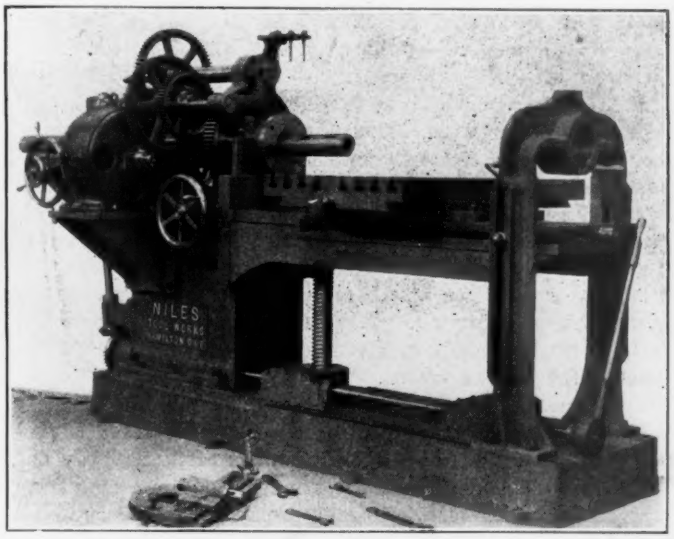


HEAVY 54-INCH X 54-INCH X 32-FOOT FRAME PLANER. —POND MACHINE TOOL CO. SPECIAL FLYWHEEL DRIVE FROM A 20-H.P. CONSTANT-SPEED CROCKER-WHEELER MOTOR.
(Horizontal Boring Machine in background at right.)

COLLINWOOD SHOPS.—LAKE SHORE & MICHIGAN SOUTHERN RAILWAY.

vided with an automatic down-feed, the screw for which is provided with a graduated collar reading to .001 in. The vise is of a special design in which the fixed jaw extends down to a scraped bearing on the table, thus providing an unusually large footing. Ball bearings are used under the elevating screw for the rail, and also the length of the stroke is very easily changed while the machine is in motion.

The 36-in. planer (tool No. 17) illustrated on page 103, as well as the 54-in. planer (tool No. 15) shown on page 104, are motor-driven planers built by the Pond Machine Tool Company, the former driven by a 7½-h.p. multiple-voltage, and the latter by a 20-h.p. constant-speed Crocker-Wheeler motor. The table of the latter planer is driven by a train of cut gearing

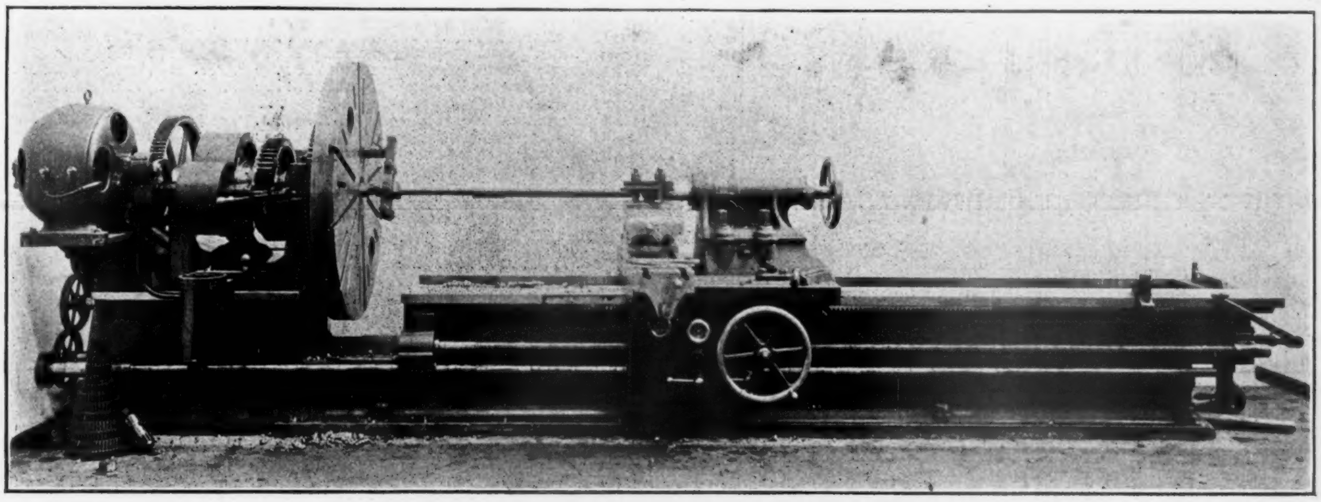


60-INCH HORIZONTAL BORING AND DRILLING MACHINE.—NILES TOOL WORKS CO. DRIVEN BY A 5-H.P. MULTIPLE-VOLTAGE C.-W. MOTOR.

from the motor, located at one end of the bed, to the longitudinal splined shaft, which delivers to the two movable heads. These heads are thus independently driven, and they have independent variable-speed feeds, as well as hand, and rapid power, movements along the bed in either direction. This machine has a length of stroke of 21 ins., and a distance between housings of 44¾ ins., with a height under housings of 23 ins.

The 60-in. Niles horizontal boring and drilling machine (tool No. 18) illustrated on this page presents a splendid example of a motor application for the drive. The motor, which is a 5-h.p. multiple-voltage Crocker-Wheeler motor, is mounted upon a bracket bolted to the front side of the frame. The drive is through a double reduction of gearing which is arranged for two changes of speed by slip gears; these speed changes, together with the machine's back gear attachment and also the multiple-voltage system at the motor, provides a wide range of speeds. The spindle of this tool has a 54-in. traverse of two settings, the maximum distance from the center of spindle to the cross table being 23 ins. and to the long table 30 ins. This type of machine furnishes the best known means of quickly and accurately boring a number of parallel holes in work without loosening the clamp-bolts from the table.

The gap lathe illustrated below is the 28-48-in. extension gap lathe (tool No. 35) built by Edwin Harrington, Son & Co., Philadelphia, Pa., and is driven by a 7½-h.p. multiple-voltage Crocker-Wheeler motor. The drive is, on this tool as on the boring machine, through two reductions of gearing which has two speed changes by means of slip gears; in this way the wide range of speed is secured. This gap lathe has particular advantages for the repair shop. As an improvement on the ordinary gap lathe, the extension feature permits making the gap wide or narrow to suit the work; also allows turning a much longer shaft, as the distance between centers may be doubled by extension of top portion of bed. With ample



28-INCH—48-INCH EXTENSION GAP LATHE.—EDW. HARRINGTON, SON & CO. DRIVEN BY A 7½-H.P. MULTIPLE-VOLTAGE CROCKER-WHEELER MOTOR.

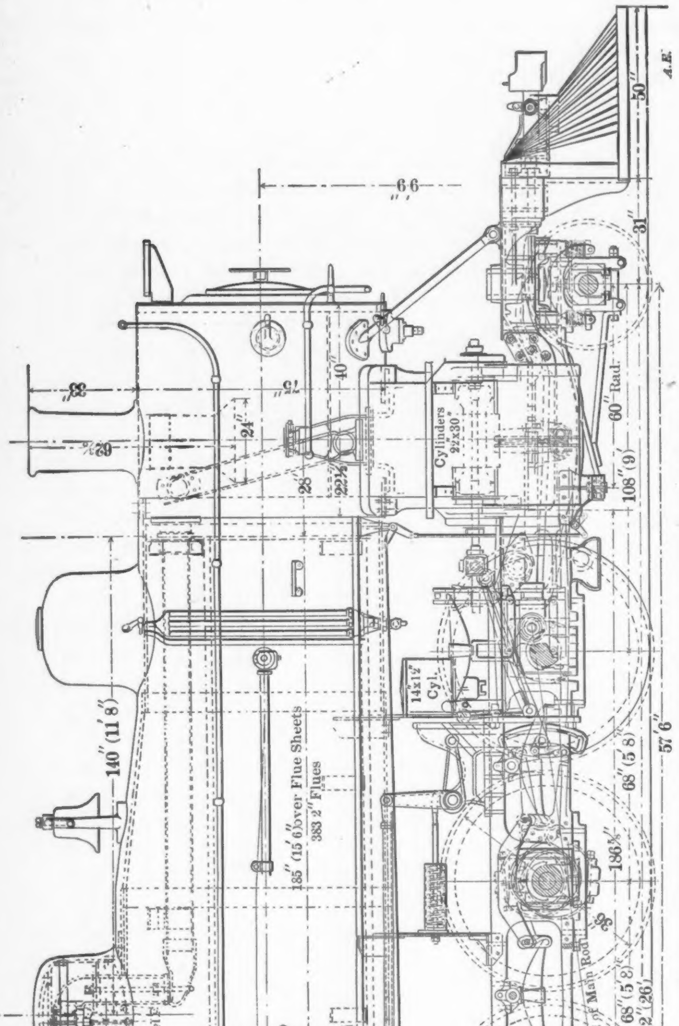
COLLINWOOD SHOPS.—LAKE SHORE & MICHIGAN SOUTHERN RAILWAY.

and rack mounted in bearings and from a crossed belt for the cutting and an open belt for the return motion by means of a shaft driven by an electric motor on the arch. The belt-shifter guides one belt entirely off the pulley before starting the other on, permits stopping the table instantly from either side without stopping the belts, and is arranged to clear the reversing dog, allowing the work to be run from under the tool for inspection.

The upper engraving on page 104 illustrates the double-head locomotive-frame slotting machine (tool No. 14), built by Bement, Niles & Co. This tool is driven by a 20-h.p. multiple-voltage motor. The drive is a direct-geared reduction drive

power to turn up to the full diameter of swing over lower bed, it has capacity for a wide range of work and is handy to operate.

Remarkable progress has been made in the development of the Cooper-Hewitt electric vapor lamp. The most recent development is the discovery of an application of this vapor tube principle to transforming alternating current to direct current; when alternating current is passed through the lamp only one polarity of the wave is conducted by the vapor, thus effecting a rectification from which a continuous flow of direct current may be drawn.



FREIGHT LOCOMOTIVE.—2—8—0 TYPE.—CHICAGO, ROCK ISLAND & PACIFIC RAILWAY.
BUILT BY AMERICAN LOCOMOTIVE COMPANY, BROOKS WORKS.

FREIGHT LOCOMOTIVES.

2—8—0 TYPE.

CHICAGO, ROCK ISLAND & PACIFIC RAILWAY.

These drawings and photograph illustrate an order of 135 heavy freight locomotives now being built for this road at the Brooks Works of the American Locomotive Company. The weights are a little less than those of the Burlington engine, illustrated last month, and so also is the heating surface. The extent of the order and the fact that this is the most powerful engine thus far used on the Rock Island confirm the observation made last month to the effect that there is a systematic tendency toward a marked but gradual increase in power of freight locomotives. These engines form a part of an order of 225 placed last year by this road with the American Locomotive Company.

Among the details the valve gear and frame construction are specially interesting. The valves are of the inside admission type and the clearances are unusually small, as the sectional engraving shows. This drawing also illustrates the direct or straight-line construction of the motion bar with reference to the jaws at its ends, and the same idea is carried out in the crosshead attachment to the valve stem. The rocker box furnishes a long bearing for the rocker, which is a substantial steel casting. This is a development to which special attention has been given for several years in the designs by the Brooks Works.

The frames are in a single piece, with no splices, and they are of cast steel, 5 ins. wide. These works have taken advantage of the fact that cast-steel frames are easily made in one piece. At their front ends the frames stop immediately in front of the cylinders, where they are bolted to a large steel casting forming the front deck and spindle guide in one piece. This construction is shown in the elevation drawing and also in the detail drawing of the frames.

RATIOS.

Tractive effort	39,000 lbs.
Heating surface to cylinder volume	247.3
Adhesive weight to heating surface	55.14
Adhesive weight to tractive effort	4.61
Tractive effort to heating surface	11.94
Heating surface to grate area	65.28
Tractive effort × diameter of drivers to heating surface	752.2
Heating surface to tractive effort	8.36%
Total weight to heating surface	61.4

FREIGHT LOCOMOTIVE, 2—8—0 TYPE.

Chicago, Rock Island & Pacific Railway.

General Dimensions.

Gauge	4 ft. 8½ ins.
Fuel	Bituminous coal
Weight in working order	200,500 lbs.
Weight on drivers	180,000 lbs.
Weight engine and tender in working order	345,000 lbs.
Wheel base, driving	17 ft.
Wheel base, rigid	17 ft.
Wheel base, total	26 ft.
Wheel base, total, engine and tender	57 ft. 6 ins.

Cylinders.

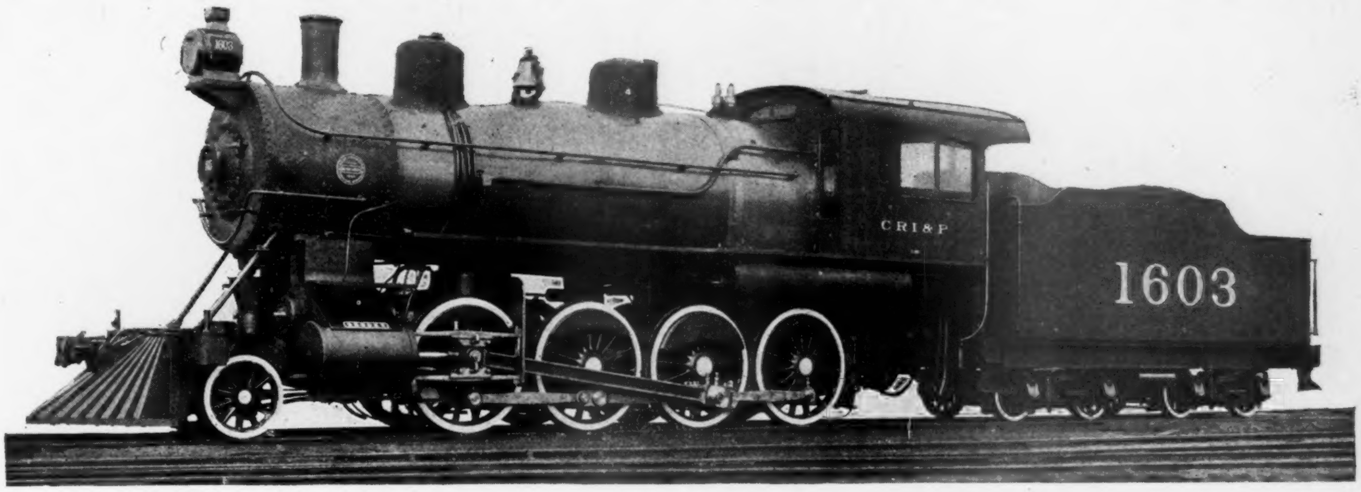
Diameter of cylinders	22 ins.
Stroke of piston	30 ins.
Horizontal thickness of piston	21 61-64 ins.
Diameter of piston rod	4 ins.
Kind of piston-rod packing	U. S.
Size of steam ports	2 ins. x 29 ins.
Size of exhaust ports	Area, 65 sq. ins.
Size of bridges	2 13-16 ins.

Valves.

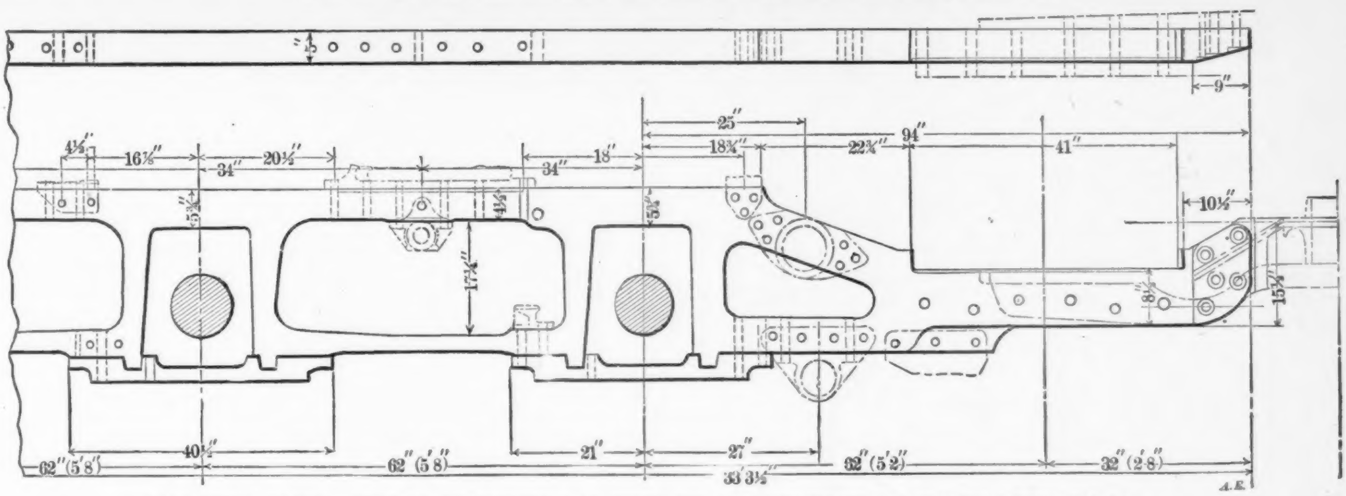
Kind of valves	Improved piston
Greatest travel of valves	5 13-16 ins.
Outside lap of valves	1 in.
Inside lap of valves	0 in.
Lead of valves in full gear	—3-32 in.

Wheels, Etc.

Number of driving wheels	8
Diameter of driving wheels outside of tire	63 ins.
Material of driving wheel centers	Cast steel
Thickness of tire	3½ ins.
Driving box material	Cast steel
Diameter and length of driving journals: Main, 10 ins. diameter by 12 ins.; others, 9 ins. diameter by 12 ins.	
Diameter and length of main crankpin journals	7 ins. diameter by 7 ins.
Diameter and length of side-rod crankpin journals	7½ ins. diameter by 5 ins.
Engine truck, kind	Radial and swing
Engine truck journals	6 ins. diameter by 12 ins.
Diameter of engine truck wheels	36 ins.



2—8—0 TYPE FREIGHT LOCOMOTIVE.—CHICAGO, ROCK ISLAND & PACIFIC RAILWAY.



CAST STEEL FRAMES—SHOWING CONSTRUCTION AT FRONT END AND ATTACHMENT TO SPINDLE GUIDE CASTING.

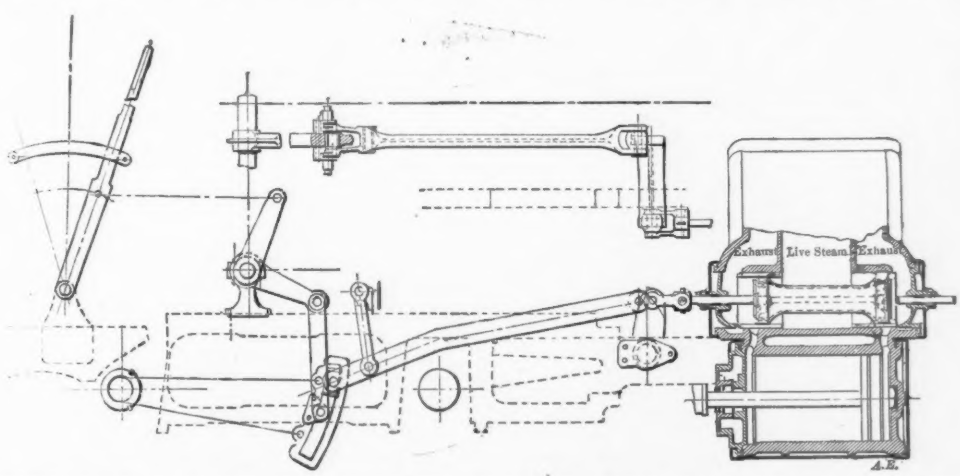


DIAGRAM OF VALVE MOTION.—THIS ARRANGEMENT GIVES A CLEARANCE OF 6.84 PER CENT., INCLUDING CYLINDER CLEARANCE, PORTS AND SPACE AROUND VALVE AND BUSHING.

Boiler.

Style ....Radial stayed and extended wagon top
Outside diameter of first ring..............................72⅛ ins.
Working pressure ....200 lbs.
Thickness of plates in barrel and outside of firebox:
¾, 25-32, 13-16, 9-16, ½, ¾ in.
Firebox, length ....108 ins
Firebox, width ....68 ins.
Firebox, depth....................Front, 75½ ins.; back, 61½ ins.
Firebox plates, thickness:
Sides, ⅜; back, ⅜; crown, ⅜; tube sheet, ⅝
Firebox, water space..........Front, 4 ins.; sides, 4 ins.; back, 4 ins.
Firebox, crown staying....................................1 in.
Firebox, stay bolts ....1 in.
Tubes, number 383
Tubes, diameter ....2 ins.
Tubes, length over tube sheets....................15 ft. 6 ins.
Heating surface, tubes ....3,087 sq. ft.
Heating surface, firebox ....177 sq. ft.
Heating surface, total ....3,264 sq. ft.
Grate surface ....50 sq. ft.
Exhaust pipes ....Single
Exhaust nozzles ....5½ ins. diameter
Smokestack, inside diameter ....16¾—15 ins.
Smokestack, top above rail ....15 ft. 7½ ins.

Tender.

Style ....Eight wheel
Weight, empty ....57,220 lbs.
Wheels, number 8
Wheels, diameter ....33 ins.
Journals, diameter and length..............5½ ins. diameter by 10 ins.
Wheel base ....18 ft.
Tender frame ....13-in. channel
Water capacity ....7,000 U. S. gals.
Coal capacity ....15 tons

INFLUENCE OF TIME ELEMENT ON MECHANICAL AND TRANSPORTATION MATTERS.*

To the Editors:

We should not pass over lightly and without due consideration any suggestion which might place the correct interpretation of mechanical department results before those interested or affected. It is only a slightly lesser duty of the mechanical department officials to see that the result of their operations is made intelligible and correct in substance than that they repair properly and at a reasonable expense the cars and engines in their charge. Certainly the work done is an item which must be taken into account, and any *element* which affects the work done is a proper subject for consideration. The proper presentation of reliable statistics has often been a safeguard against the unreasoning prejudice of jealous or unfriendly officials. Hence we should be alert and should oppose comparisons which do not compare and statistics which neglect, without reason, important elements of the proposition.

I must confess that my conversion to the "tonnage basis" came as a matter of self-defense rather than from any innate desire to try what I then thought to be a "new-fangled" and rather unnecessary way of doing things. I felt quite secure on the locomotive cost per mile basis so long as it was satisfactorily comparable with previous years and our lighter power avoided any worry about our neighbors' results. With the advent of heavier power we had forcibly presented to us an important part of the proposition, demonstrating that our figures did not give favorable comparisons with those made by us for previous years. It is safe to say that it did not take long to convince us that what the machine actually did was the proper measure of efficiency.

The subject of tonnage rating has been before the Master Mechanics' Association since 1898, and the reports are really good reading; not so much when considered year by year as when taken in their entirety as showing the development of what has at times seemed to many of us an almost hopeless, if not needless, task. The earliest report shows that it was almost impossible to get up a general discussion of the subject. The members were apparently awed by the variable elements entering into the proposition, as well as by its newness. With the advent of 1899 there was aroused a more general interest in the subject of ton-mile statistics, and with the general discussion in the railway clubs and mechanical papers, and with possibly some inquiries from our superior officers on the subject, the problem became one of moment. The association almost from the start has taken the position that "it would be difficult to produce a form of locomotive statistics that would show entirely fair comparisons one system with another." Yet the desire for comparison is extant and the attempts to compare go on. Those who are at the helm still desire to know whether we do as well as previously, as well as our neighbors, and as well as we should do. Out of this condition will not a farther development of the system be demanded?

The world of finance loves statistics, and we may as well give a small boy a gun and a cartridge with the hope that he will not try to put them together as to expect that those who own, control or invest in a property will not compare statistics at hand, either for comfort, advertisement, or whatever may suit their purpose. If the above be reasonable, is it at all certain that a declaration of the association made in 1899 to the effect that we can afford to neglect the element of time in our statistics will be allowed to stand? Will not the development of the system finally call for a recognition of all the variable elements which may vitally affect the service, in order for us, so far as possible, to place figures in such shape as will best fit comparison, which we may not approve, but which are bound to be made? We are, I feel, quite well on the way to the use of the tonnage basis for passenger service; and it would seem to me that a committee which can solve the problem of the switching locomotive and allowance in the tonnage problem may be able to go still farther. Certainly the matter of overtime is looked after more or less closely on most all lines, and the disposition of wages paid for it and the effect on general results in specific cases have been often noted. While the over normal time element may be in many cases a negligible quantity on account of its smallness, there are many kinds of service and many branches on the average railroad where such is not the case. It would seem to me it is pertinent to inquire into how far the time element can justly be considered or neglected in railroad service. That the idea has some foundation for investigation is evidenced by the fact that there is a Master Mechanics' Association committee on the cost of running high-speed trains. We will surely have to take the time element into account on high-speed trains if figured on a tonnage basis. However, we must not force into our statistics any element which may mean a "splitting of hairs," and I hold that we are benefited by having in our statistics only such elements as we will, on analysis, see we should be able to explain or control.

W. A. NETTLETON.

*See article on this subject by H. T. Herr on page 84.

TYPOGRAPHICAL ERRORS.

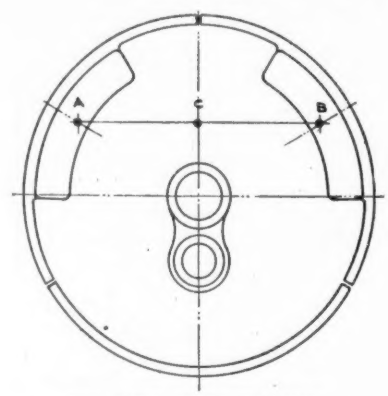
In the article by Mr. Herr in the seventh line from the bottom in the first column on page 84, for "833,300 ton miles" read "1,000,000 ton miles," and in the next line below for "but little more than half" read "two thirds."—EDITOR.

THE DAVIS COUNTERBALANCE.

To the Editors:

Considerable attention has recently been given by the various railroad periodicals to the "Davis Counterbalance" and its supposed virtues, first among which is claimed a great improvement in the distribution of the ordinary hammer blow and the consequent ease of riding of the engine. There can be no harm in inviting criticism at least by the following opinion:

If, on the attached diagram, we let A represent the center of gravity of one counterweight and B the center of gravity of the other counterweight of the Davis counterbalance, it is a well known fact of mechanics that the common center of gravity of these two bodies lies at the middle of a straight line which connects these



THE DAVIS COUNTERBALANCE.

two centers of gravity, or at a point marked C, which is on the vertical diameter of the wheel center. It therefore follows that the real effect which these two separated counterbalances produce is exactly equivalent to the effect which would be produced if their combined weight could be collected and placed at the point marked C. This could readily be done by disposing of the counterbalance weight A and B and putting one counterbalance weight equal to their combined weight at the point C. Now it is plainly evident that this is nothing more nor less than going back to the original form of counterbalance used in every day practice, viz., one large weight of any form whatever, directly opposite to the crank pin. It therefore makes no difference in what way any number of weights may be symmetrically distributed around the rim of the wheel, so far as dividing up hammer blows or anything of that kind is concerned; as long as the weights are grouped symmetrically on either side of the center line passing through the crank pin and the driving axle, the resultant effect will be the effect of their combined weight placed at the intersection of this center line and a center passing through their common center of gravity.

As the value of a counterbalance weight varies directly as its distance from the center of the axle, it follows that the Davis form of counterbalance is a very inefficient one because the common center of gravity of the Davis counterbalance necessarily lies close to the axle. It therefore follows that a great deal more weight than would ordinarily be required with a common form of counterbalance is necessary in order to get the same effect as with the common form of counterbalance, which can be placed out close to the rim of the wheel.

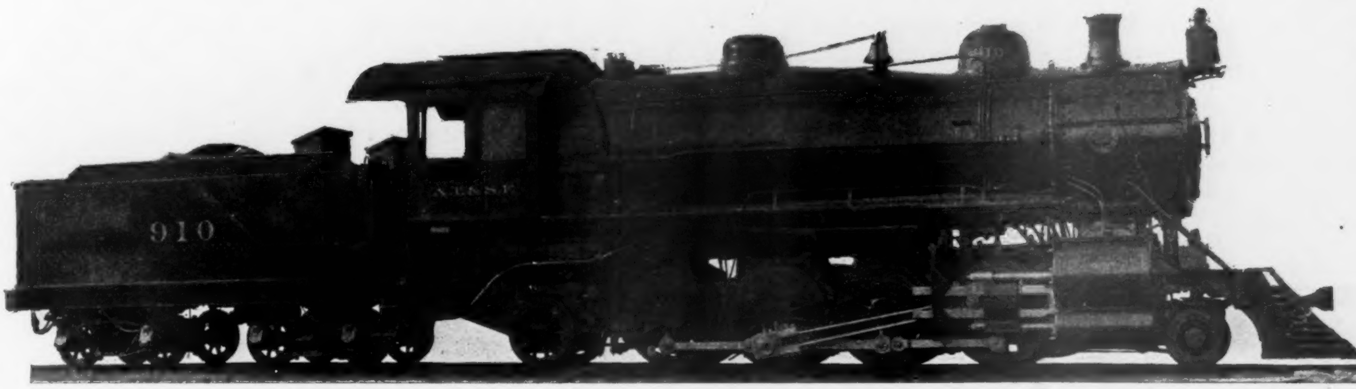
A. H. FETTERS.

HEAVY COMPOUND FREIGHT LOCOMOTIVE.

2—8—2 (MIKADO) TYPE.

ATCHISON, TOPEKA & SANTA FE RAILWAY.

Very few road engines with a weight of 200,000 lbs. on driving wheels are running in regular road service. On page 15 of the January number of this journal this design for the "Santa Fe" was illustrated and a photograph has now been received and placed before our readers. This weight gives 25,000 lbs. per driving wheel, which is raised considerably by the traction increase in starting. This is a noteworthy design in that the boiler is almost exactly like that of the heaviest locomotive ever constructed. (See AMERICAN ENGINEER, June, 1902.) The photograph shows the disposition of the whistle, the air drums, and also gives the location of the back-pressure brake.

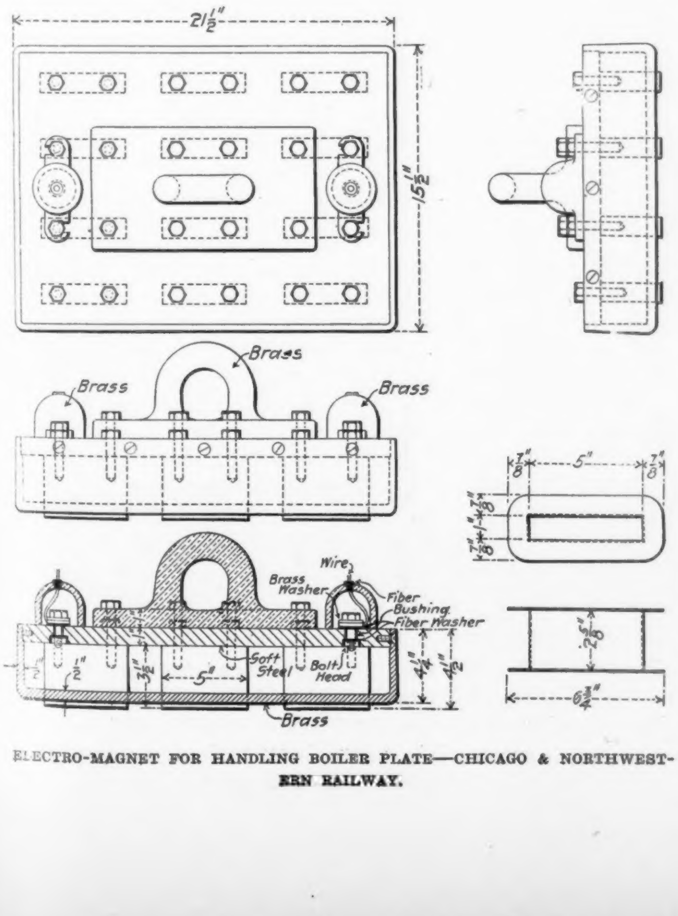


HEAVY COMPOUND FREIGHT LOCOMOTIVE—ATCHISON, TOPEKA & SANTA FE RAILWAY.
2—8—2 (MIKADO) TYPE.

MAGNETS FOR HANDLING BOILER PLATE.

This magnet is used at the general storehouse of the Chicago & Northwestern Railway, at Chicago, for handling boiler plate, frogs and other material for which it is adapted. Its construction is simple and it is available for use wherever the necessary electric current may be had.

In preparing the engraving sufficient information was included on the drawing to explain the construction. The magnet cores, 12 in number, are of soft steel and 5 x 3½ x 1 in. in size. Fifty-six pounds of No. 17 D. C. C. magnet wire was used on 12 tin magnet spools, which are well insulated with paper. The capacity in lifting is 3,000 lbs. with a 220-volt current. It is used in connection with an air hoist and a traveling crane in the storehouse yard and will lift frogs, plate, castings, or any steel or iron parts presenting favorable surfaces. A simple make-and-break switch is used to control the magnet. We are indebted to Mr. Robert Quayle, superintendent of motive power, and Mr. G. F. Slaughter, formerly general storekeeper, for this drawing.



ELECTRO-MAGNET FOR HANDLING BOILER PLATE—CHICAGO & NORTHWESTERN RAILWAY.

LOCOMOTIVE TESTING PLANT FOR CORNELL.

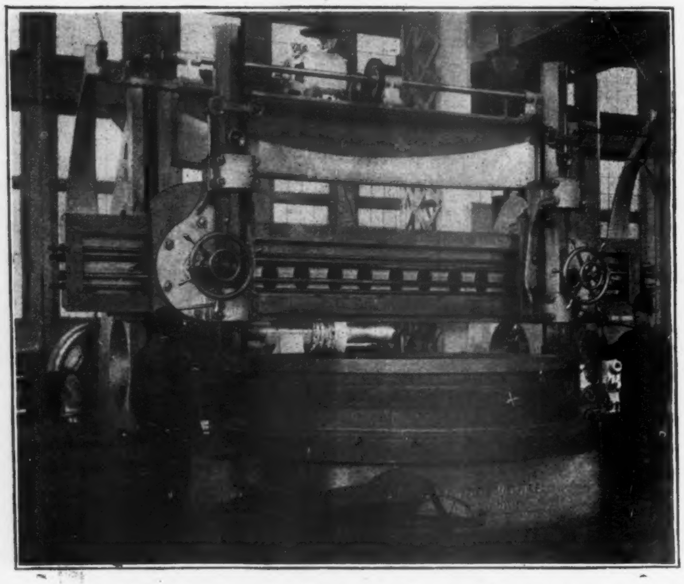
Cornell University is to have a locomotive-testing plant, for which the Baldwin Locomotive Works will donate a Vauclain four-cylinder balanced compound, to be built to designs yet to be decided upon by Prof. H. Wade Hibbard and the builders. It is probable that the engine will be the 4—4—0 type, with a boiler designed for pressures up to 300 lbs. per square inch. To utilize high pressure a traction-increaser device will be used to throw the entire weight upon the driving wheels. The plans are sufficiently perfected to assure a well-designed and completely equipped plant, but the details have not yet been worked out. Cornell University and Professor Hibbard are to be congratulated upon this important addition to the laboratory equipment of Sibley College.

It is to be regretted that the use of water-softening apparatus is so limited. At the present time there are not over two hundred plants in use in the United States, and these are to be found chiefly in manufacturing plants. The number of plants in use on the railroads of this country does not exceed thirty-five, which represents about 15,000,000 gallons of water daily. At present no road has enough purifying plants to represent the possibilities of purification. If but one of the several water stations on a division is equipped with a plant, its effect on boiler repairs does not appear to advantage, because the treated water is mixed in the tender with the untreated water. Only when entire divisions are equipped, or at terminal points, where switch engines use the water exclusively, can comparisons be made.—J. B. Greer, before Pittsburg Railway Club.

A REMARKABLE MACHINING PERFORMANCE WITH A MOTOR-DRIVEN TOOL.

An interesting machining performance was recently made with a large motor-driven boring mill at the shops of the Bullock Electric Company at Cincinnati, Ohio, which serves to demonstrate the true value of the electrical method of tool driving. The tool in use was a 12-foot Niles boring mill, direct-driven by a Bullock standard type N multiple-voltage motor, rated at 15 h.p. at a speed of 500 revolutions per minute. This motor is located within the protecting boxing shown at the left of the frame in the accompanying illustration, the motor shown on top of the frame of the tool being used exclusively for adjusting the cross rail.

The work was the large cast-iron commutator sleeve shown on the table of the machine, of which there were several for an order of 2,200-kw. direct-current generators being built by the Bullock Company for the Pittsburg Reduction Company.



VIEW OF THE BORING MILL USED IN TURNING THE COMMUTATOR SLEEVES —BULLOCK ELECTRIC MFG. CO.

The castings were of medium hard iron, and the tool steel used was the Firth-Sterling air-hardening tool steel. Both heads were used, one tool in each, the table revolving for a cutting speed of 60 ft. per minute. The depth of cut at either tool varied from ¾ to ⅞ in., due to the usual inequalities of surface of castings, and the feed was ⅛ in. at each tool, which corresponds to a feed of ¼ in. per revolution of the table if only a single tool were used.

Under this feed the metal was removed at the rate of 1,200 lbs. of chips per hour. Careful measurements were made of the power required for driving the machines under these conditions, which showed the gross input at the motor, measured electrically, to be ¼ h.p. for each cubic inch of metal removed—a very economical performance. The adaptability of the multiple voltage system cannot be better illustrated than by this operation; with the controller used on this machine, giving 26 different speeds, it was extremely easy to satisfactorily adjust the cutting speed to the capacity of the tool steel used, as a result of which this high cutting rate was obtained.

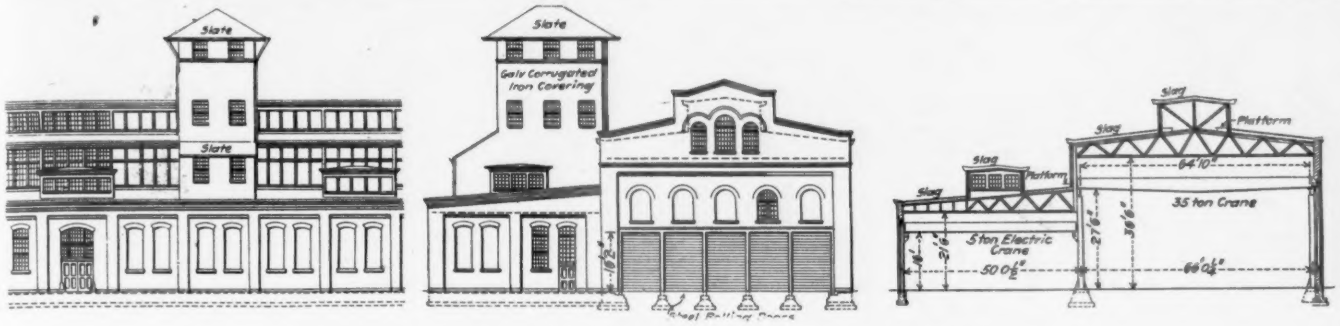
Another interesting result was recently shown at the Bullock Company's works in a comparison of machining operations. A power input test, similar to the above-described test upon the boring mill, was made upon a motor-driven rotary planer which was being operated at a high cutting rate planing cast iron. The tool was a Pond rotary planer with a 50-in. head having 60 inserted cutters, and was driven at a feed of ⅝ in. per revolution of the head, which is equivalent to a feed of a trifle over .01 in. per cutter. The amount of metal removed at this cutting rate was 1,200 lbs. per hour (20 lbs. per minute). Measurements of the power required to drive the tool showed a power input at the motor of 15 h.p.; from this it is evident that with 20 lbs. of chips removed per minute with 15 h.p., ¾ h.p. is required per pound of metal removed—an expenditure of three times as much power as was required upon the boring-mill operation.

While the actual expenditure of power per cubic inch of metal removed is of minor importance as compared with the time required for an operation in most cases, still the discrepancy in power required by the rotary planer is here very significant. It illustrates in the most forcible manner possible the effect of the multiple inserted cutter tool: with each cutter of the head having an individual feed of .01 in. the metal removed is very finely broken up—almost pulverized—while with the boring mill using only two cutting tools under very heavy feeds the metal is broken up into chips of coarser size. The rotary planer operation would naturally require more power, but it is interesting to note that it required three times as much power as the boring mill operation per unit of metal removed for that reason.

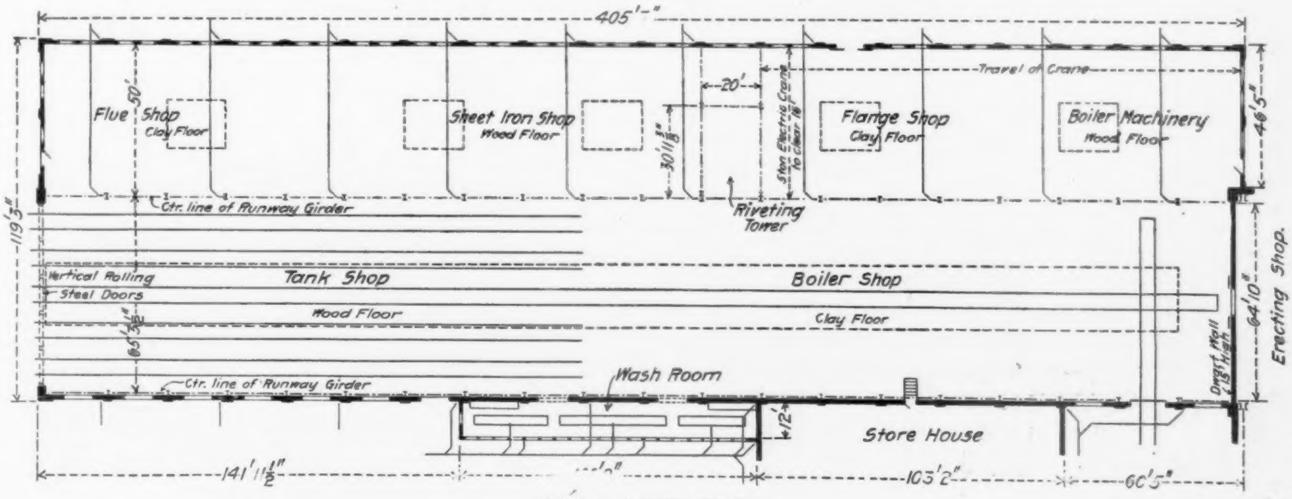
Mr. Alexander C. Humphreys was inaugurated president of the Stevens Institute of Technology at Hoboken February 5, succeeding the late president, Henry Morton, who held the office from the founding of the institute in 1870 until his death last year. President Humphreys was born in Scotland in 1851, and came to this country while a young man. After spending a number of years in business and rising to the position of secretary of the Bayonne and Greenville Gas Light Company, he arranged to study at Stevens Institute, and by employing his evenings and spare time, completed his course to graduation in 1881. He then became chief engineer of the Pintsch Lighting Company and remained until 1894, when he turned his attention to business in the firm of Humphreys & Glasgow. He has had a prominent part in constructing gas and electric lighting plants and in their management and the business interests connected with them. Coming as he does from a successful business experience, and being an energetic, forceful man, he is unusually well qualified to succeed to this important office. The many friends of Stevens Institute, as well as its nearly one thousand graduates, look forward to his administration with confidence and expectation of continued progress.

Mr. R. J. Gross, second vice-president of the American Locomotive Company, Dunkirk, N. Y., has started on a trip around the world. He goes by way of San Francisco, the first stop to be at Honolulu. From there he goes to Japan, Korea and Siam, and from China he will travel over the Trans-Siberian Railroad to Russia. He plans to visit every country in Europe. Mr. Gross will be absent from this country about a year. The purpose of his trip is to make a careful investigation of the opportunities for American locomotives in the Orient and European countries and to establish systematic business relations. Mr. Gross will be accompanied on his trip by Charles M. Muchnic, until recently mechanical engineer of the Denver & Rio Grande, who will act as Mr. Gross' secretary.

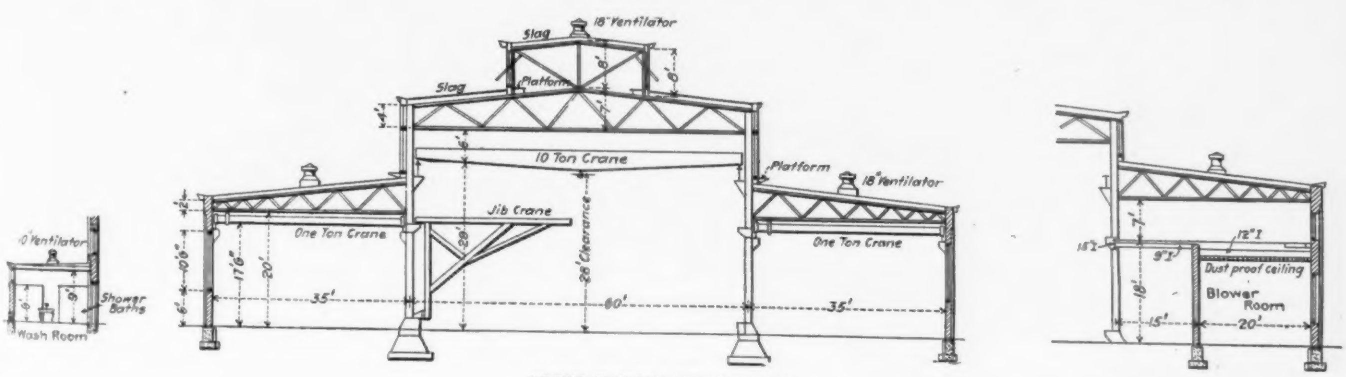
Mr. Max Toltz has resigned as mechanical engineer of the Great Northern Railway. He is engaged in superintending the application of his system of acetylene car lighting to a large number of cars on the Canadian Pacific, and has been retained by that road in a consulting engineering capacity in connection with the new shops at Montreal.



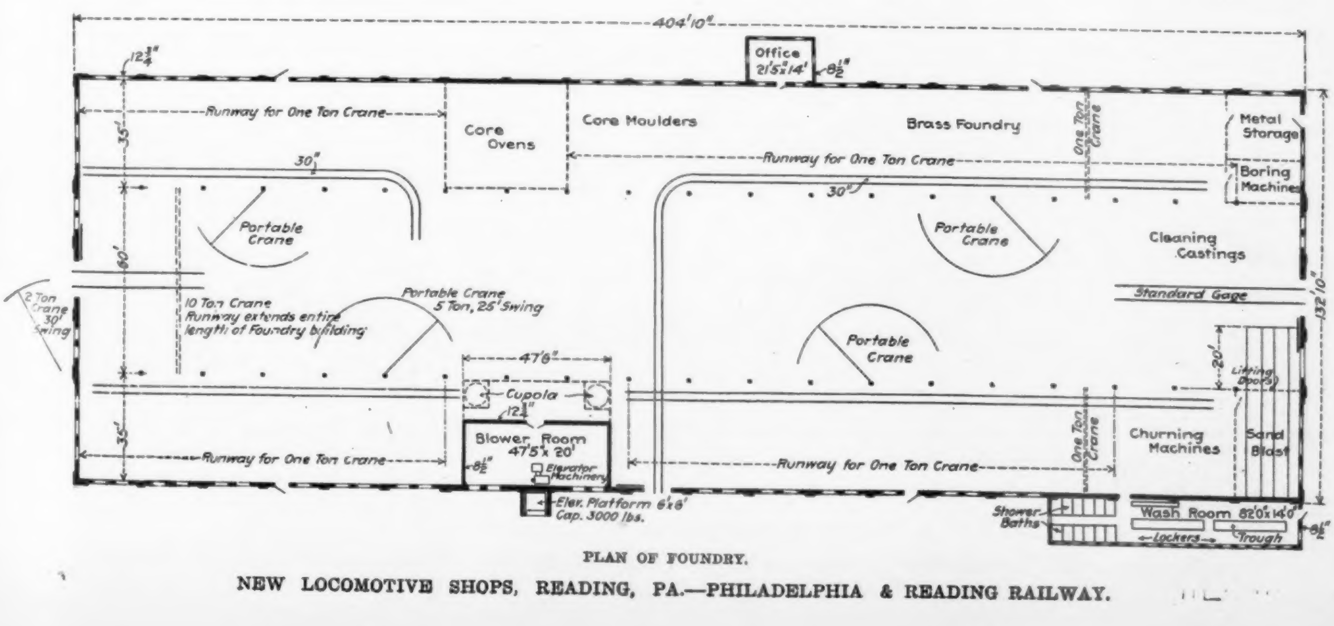
PARTIAL SIDE ELEVATION, END ELEVATION AND SECTION OF BOILER SHOP.



PLAN OF BOILER SHOP.

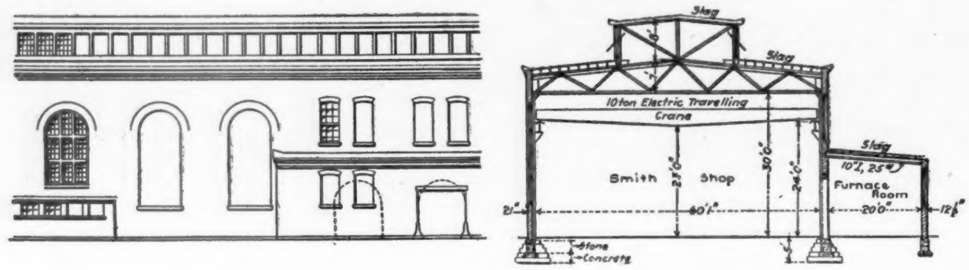


CROSS SECTION OF FOUNDRY.



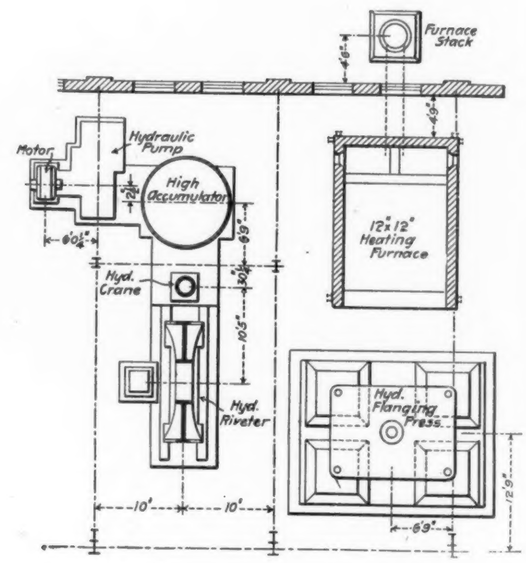
PLAN OF FOUNDRY.

NEW LOCOMOTIVE SHOPS, READING, PA.—PHILADELPHIA & READING RAILWAY.

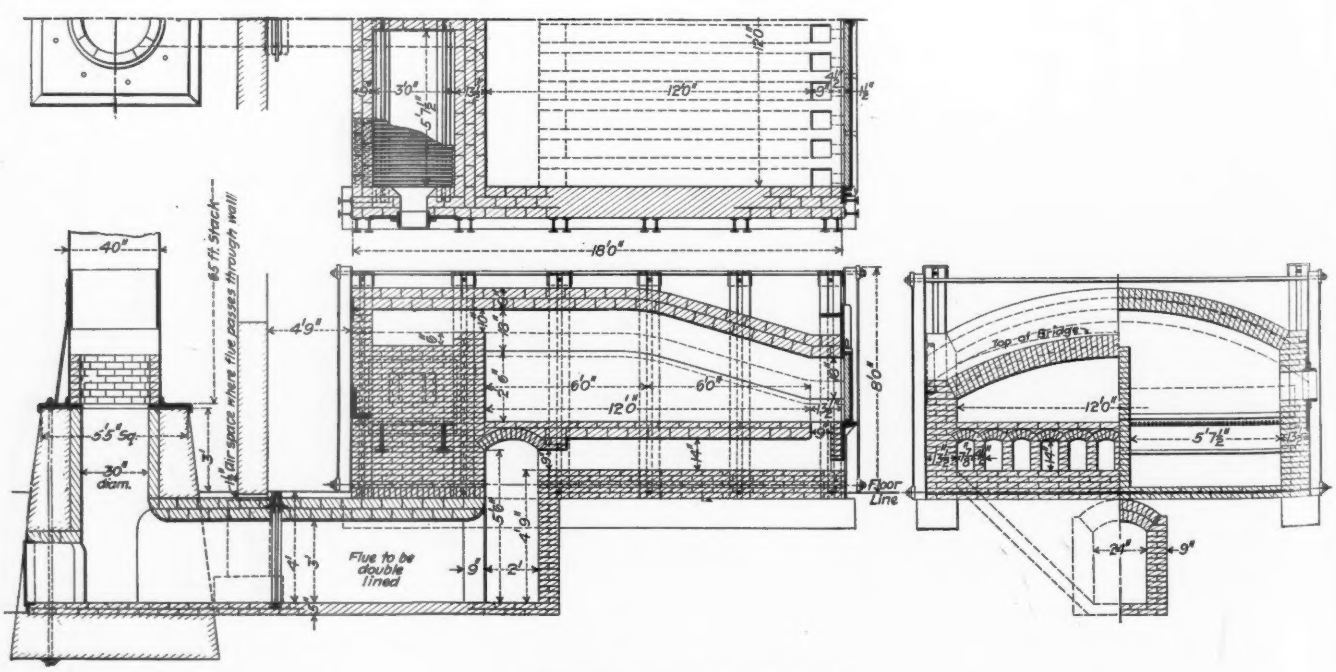


PARTIAL SIDE ELEVATION AND SECTION OF SMITH SHOP.

SECTION THROUGH STOREHOUSE, SHOWING SIDE ELEVATION OF BOILER SHOP.

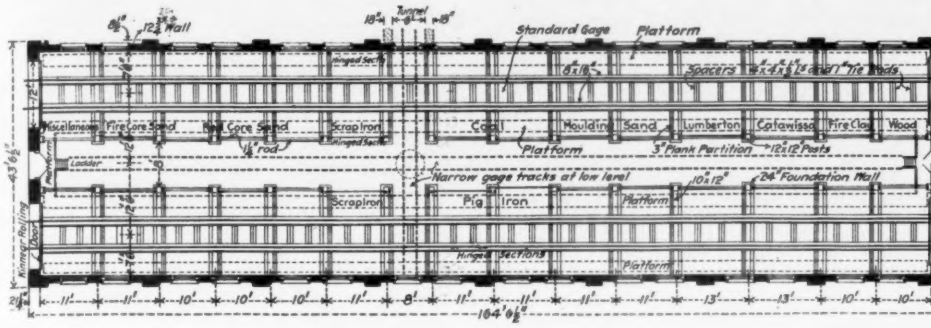


PLAN OF FLOOR UNDER RIVETING TOWER.

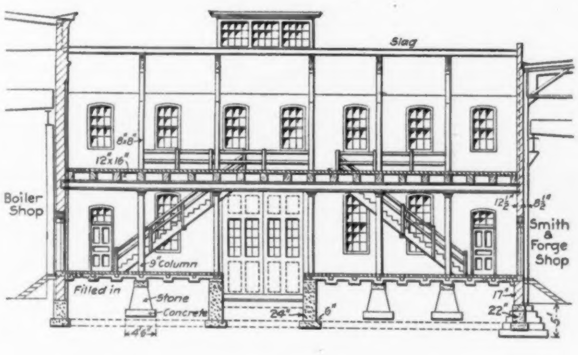


FLANGING FURNACE IN BOILER SHOP.

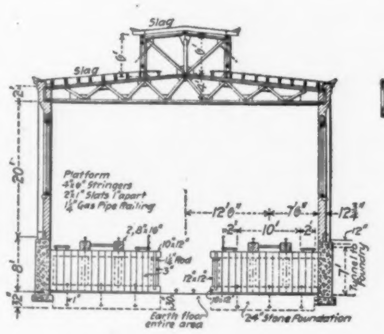
NEW LOCOMOTIVE SHOPS, READING, PA.—PHILADELPHIA & READING RAILWAY.



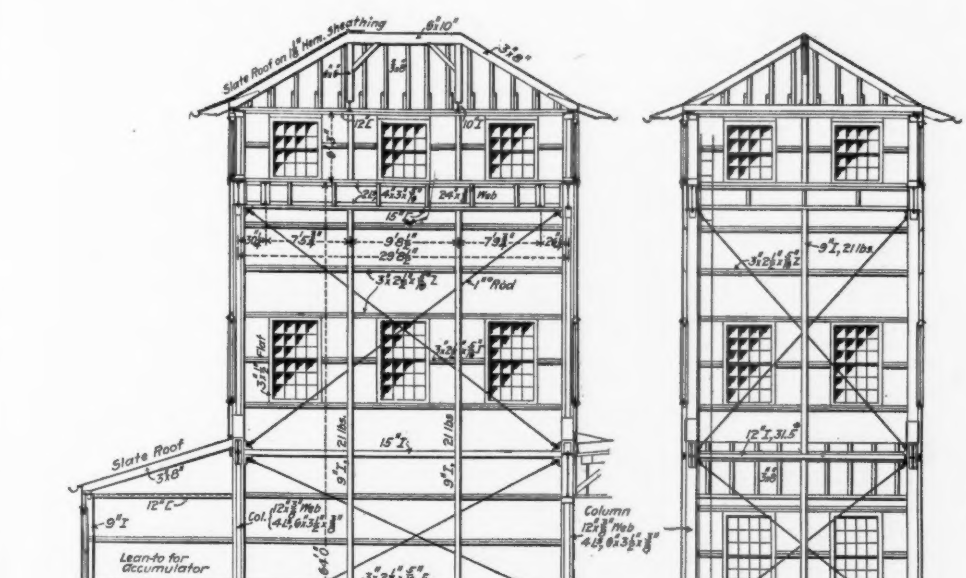
FLOOR PLAN OF FOUNDRY STOCK HOUSE.



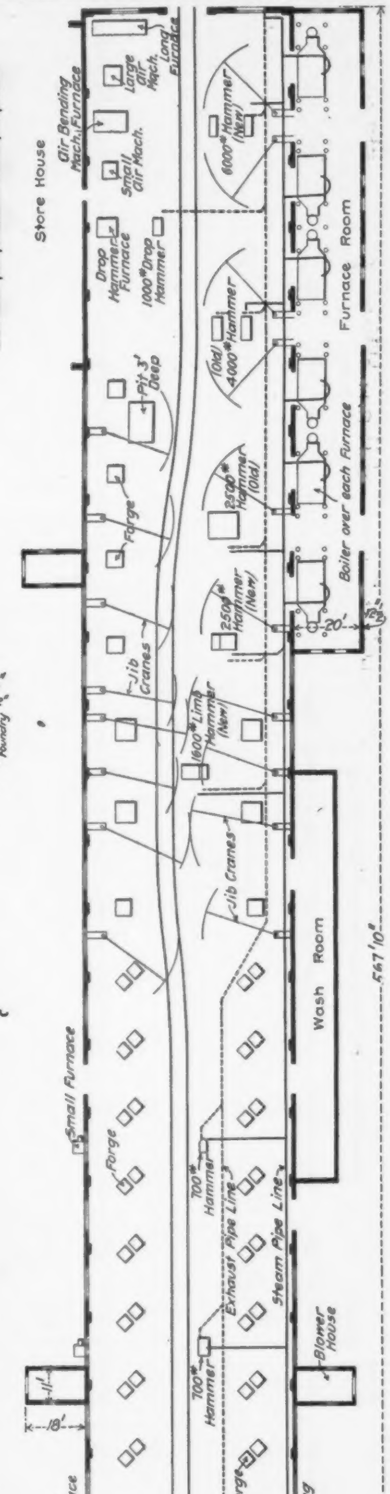
SECTION THROUGH STOREHOUSE.



SECTION THROUGH STOCK HOUSE.



FRAMING OF RIVETING TOWER.



FLOOR PLAN OF SMITH AND FORGE SHOPS.

NEW LOCOMOTIVE SHOPS, READING, PA.—PHILADELPHIA & READING RAILWAY.

NEW LOCOMOTIVE SHOPS.

PHILADELPHIA & READING RAILWAY.

III.

(*For previous article see page* 53.)

In the February number the locomotive erecting and machine shop was described in detail. The other buildings are of similar character but of lighter construction, to adapt them to their special purposes.

BOILER SHOP.

This building has a main bay and a 50-ft. lean-to. The main bay provides for boiler and tank work and is served by a 35-ton crane on runways extending over the dwarf wall into the erecting shop. One track extends through this bay and four other tracks 180 ft. long provide for the tank work. In the lean-to is a space of 400 x 50 ft. for machinery and the riveting and flanging equipment. A monitor extends almost the entire length of the main bay and five ventilators each having 16 sash are provided for in the roof of the lean-to. The arrangement of the glass in the roof is shown in the photograph of this building on page 12 of the January number. This building has a slag roof over hemlock roof boards. The floor of the erecting flue and flange departments is of earth and that of the rest of the building of wood. From the north end of the building to the riveting tower the lean-to is served by a 5-ton electric crane, controlled from the floor of the shop. This covers all of the space over which boiler plates are handled.

The riveting and flanging outfits are placed under a riveting tower located over the roof of the lean-to and about 150 ft. from the north end of the shop. In the tower is a crane to serve the riveter and a small lean-to, on the roof of the shop lean-to and built from the tower, provides for the accumulator for the riveter, flanging press and hydraulic punch. The hydraulic machinery warrants a separate description. The installation of a flanging press in a railroad repair shop is somewhat unusual. In the small plan of the space under the riveting tower the location of the flange furnace is shown and its construction is illustrated by sectional views. The smoke flue passes under the wall of the shop connecting to the stack which is seen in the photograph on page 12.

SMITH AND FORGE SHOP.

This building is 568 x 60 ft. The north half is the forge shop and the south half the smith shop. A lean-to 180 x 20 ft. provides a furnace room outside of the main wall of the forge shop. The roof has a slag covering and the floor is of earth throughout. A 10-ton electric traveling crane serves the entire shop and the forge shop has 17 jib cranes for the hammers and fires. The furnaces are fired with coal. Over each of the six furnaces a horizontal tubular boiler is placed to utilize the waste heat. These furnish steam for the hammers and the exhaust is piped to the general heating system and to the atmosphere through a pressure retaining valve. Smaller furnaces are located in the shop, as shown in the plan, which shows the location of the bending machinery and forges.

THE FOUNDRY AND STOCK HOUSE.

This building is 400 x 130 ft. It has a center and two side bays. A 10-ton crane covers the whole of the center bay and each lean-to has a 1-ton crane operated by compressed air and having shorter runways because of the core ovens and cupolas. In the main bay there are also 4 portable electric cranes. The glazing in this building is shown in the photograph on page 13. In the plan the arrangement of the floor space is indicated.

Special attention was given to the stock house for the foundry. It is seen in the third photograph on page 13. This building is 161 x 40 ft. and has two standard gauge tracks, one on each side, extending into the building at the yard level. Under these tracks are bins for the storage of foundry material. On a level with the floor of this building and the floors of the bins is a push car track with a turn-table at the center of the building. From the transverse track the loaded cars are pushed into the foundry through a tunnel to the foundry elevators to the cupolas or to the foundry floor, as required. Kinnear rolling shutters are fitted to the track doors.

CARPENTER AND PATTERN SHOP.

In this building, 200 x 60 ft., with three and one-half stories, all of the woodwork of the plant is concentrated. The main floor provides for dry lumber storage at the south end, next to this is the paint shop for cabs and special work, while the north end contains the electrician's store-room and repair shop and the scale department. The second floor is used for a general woodworking shop, including the pattern shop. The third and fourth floors are used for pattern storage. This building is well lighted and convenient. It has two exterior elevators with 10 x 12 ft. platforms, one on the south end and the other on the west side of the building. This building has an iron fire-escape at the north end.

STORE HOUSE.

As shown in the general ground plan, on page 10, the storehouse is built between and connected to the boiler and smith shops. It is also near the machine and erecting shops. The building is 100 x 70 ft., two stories high and equipped with an elevator with a 6 x 9 ft. platform. The track running through its center extends also through the locomotive machine shop. The storehouse floor is raised to the level of the floor of a freight car. Between this track and the elevator is a platform scale. Light for the lower floor comes through two wells through the second floor, over which are the roof monitors.

OFFICE BUILDING.

This building has three floors, the second being on the level with the street. The lower floor, 12 ft. below the street level, provides for the offices of the general foreman, shop clerical forces and timekeepers. On the second or main floor are the offices of the superintendent of motive power and master car builder, with their clerks. The arrangement of the rooms was shown in the large ground plan on page 10. A large room occupies the greater part of the floor with a large vault at the north end and toilet rooms in the corners. Other offices are located on each side of the hall at the south end. The drawing room on the third floor is a fine, large, well lighted room. A cement-floored blue-print room, office for the chief draftsman and electrical engineer and the large drawing room occupy the whole floor.

In such large shop buildings it was necessary to employ devices whereby the inaccessible windows in the monitors may be quickly closed in case of sudden storms. In the locomotive shop the sashes are operated in lengths of about 100 ft. by shafts of 1¼-in. pipe. These are rotated by means of air cylinders 6 x 10 ins. in size, which are controlled from a central point at the foot of one of the roof columns. The other buildings have the Evans window-controlling devices supplied by the Quaker City Machine Company, of Richmond, Ind. These are operated by hand.

The power house and machinery equipment of the plant will be the subjects of separate articles.

The Great Western Railway, of England, has ordered a Du Bousquet four-cylinder compound locomotive in order to make a close study of the French locomotives with respect to English conditions. In this case not only the locomotive but the runner, the fireman, and also, perhaps, the fuel, are to be imported for the purpose of testing the merits of the French practice under the best conditions obtainable.

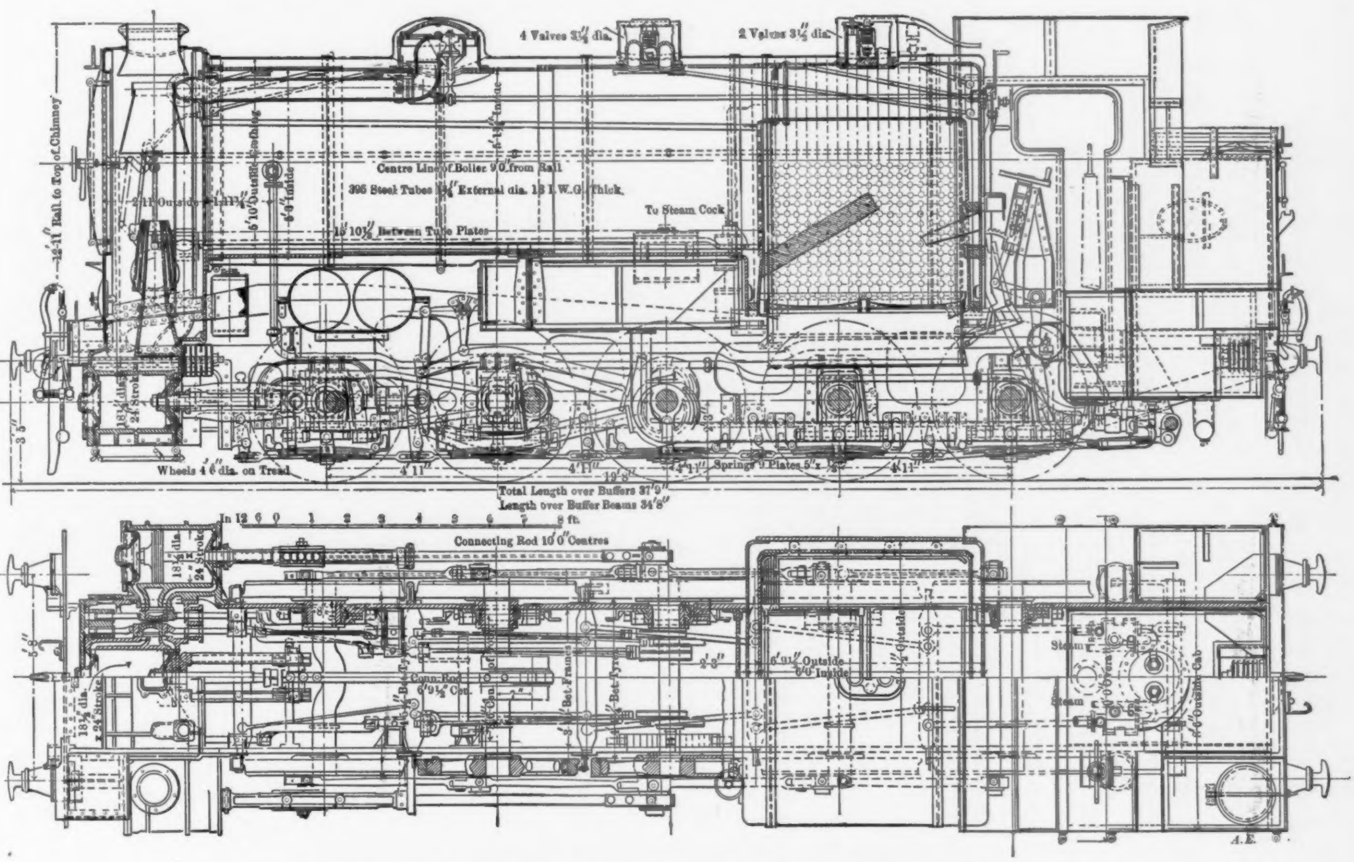
POWERFUL ENGLISH SUBURBAN LOCOMOTIVE.

Great Eastern Railway.

This road has a very important suburban service, which is constantly increasing, and in order to handle it punctually with its existing schedules this interesting locomotive was designed by Mr. James Holden, locomotive superintendent of the road, and one has been built at the Stratford shops.

It has ten 54-in. driving wheels and a wheel base of 19 ft. 8 ins., the central pair being flangeless. It is a simple engine, with three 18½ by 24-in. cylinders, two of which are outside and the other inside the frames. The inside cylinder connects to a central crank on the second axle, and, to provide clearance for the crosshead, the leading driving axle is cranked. The connecting rod is 6 ft. 9½ ins. long between centers, and is made in the form of a triangular frame, one leg of which passes above and the other below the leading axle. The cranks are set at angles of 120 deg. to each other. The boiler is large, and appears to be up to the limit of size for this road. It provides 3,010 sq. ft. of heating surface and 42 sq. ft. of grate area, these figures being the largest ever employed in English locomotive practice. This boiler has six 3½-in. safety valves. The boiler pressure is 200 lbs.

This is a remarkable locomotive, and it gives an impression of the difficulties presented by suburban service of the present time. That the most powerful locomotive in England is designed specially for suburban service indicates the severity of the conditions. We are indebted to *Engineering* for these engravings.



POWERFUL SUBURBAN LOCOMOTIVE, WITH THREE CYLINDERS.

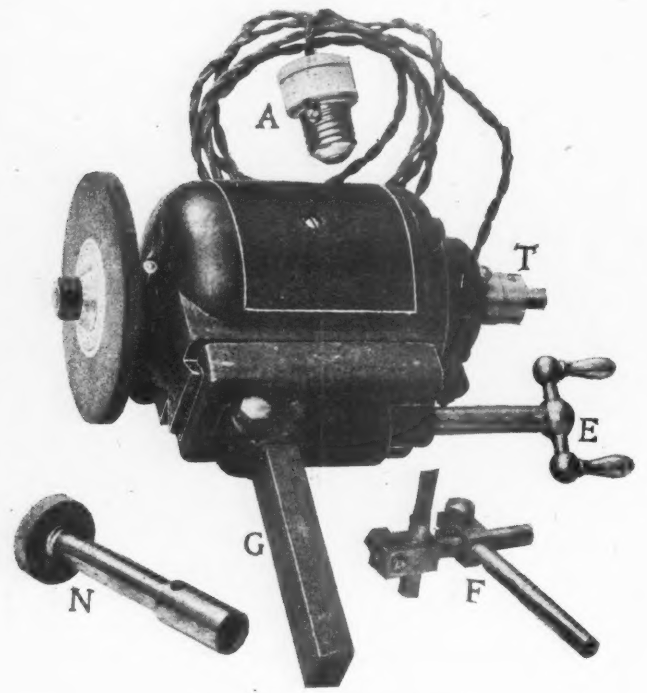
GREAT EASTERN RAILWAY.

ATOMIZERS FOR LIQUID FUEL.

In using oil fuel in marine service the use of steam for atomizing is important, and this was the subject of careful attention by the "Liquid Fuel Board" of the navy department. It was found that with steam atomizing burners the average percentage of steam required for the burners was about 4½ per cent. of the entire evaporation of the boilers. Such a consumption of water that must be made up by evaporators on shipboard leads to the use of air as an atomizing agent. Concerning the matter of steam in the flame, the recent report of Rear Admiral Melville states that there is quite a widespread misconception regarding the part that the steam which is used for atomizing purposes plays in effecting combustion. It is supposed by many that after atomizing the oil the steam is decomposed and that the hydrogen and carbon are again united, thus producing heat and adding to the heat value of the fuel. While it may be true that the presence of steam may change the character and sequence of the chemical reaction, and result in the production of a higher temperature at some part of the flame, such an advantage will be offset by lower temperatures elsewhere between the grate and the base of the stack. All steam that enters the furnace will, if combustion is complete, pass up the stack as steam, also carrying with it a certain quantity of waste heat. The amount of this waste heat will depend upon the amount of steam and its temperature at entrance of the furnace. The quantity of available heat, measured in thermal units, is undoubtedly diminished by the introduction of steam. In an efficient boiler it is quantity of heat rather than intensity that is wanted. For many manufacturing purposes intensity of heat may be of primary importance, but in a marine steam generator a local intense heat is objectionable on other grounds than those of economy, viz.: its liability to cause leaky tubes and seams from the unequal expansion of heating surfaces.

A PORTABLE ELECTRICALLY DRIVEN GRINDING MACHINE.

A valuable feature of the equipment of the new Collinwood shops of the Lake Shore & Michigan Southern Railway is to be found in the addition of a number of the Hisey portable electrically driven grinders for use as attachments to lathes, planers, milling machines, etc., for various grinding operations. The Hisey motor grinder, which was recently put upon



THE HISEY PORTABLE GRINDER.

the market in an improved form by the Hisey-Wolf Machine Company, Cincinnati, Ohio, involves in its construction some valuable features. It is a tool of unusual value on account of its ready and easy application to a large number of otherwise difficult operations, and its time-saving qualities, due to simplicity of application and operation.

This device, which is illustrated in the accompanying engraving, consists of an iron-clad bipolar electric motor, with an emery wheel attached directly upon the end of its armature shaft, the whole of which may be mounted in the tool-post of a machine tool. The motor is built in the most substantial manner, according to a design especially calculated for the high speed necessary. The high speed is obtained by a two-pole design of field magnet frame, which provides a closed magnetic circuit and also a perfect mechanical protection for the armature and its commutator.

The motor illustrated in the engraving runs at a speed of 4,500 rev. per min., a special design of toothed armature being used to withstand this speed. The notchings for receiving the wire are very narrow near the periphery, but widen out farther in; this permits a wedge to be driven in after the armature conductors are in place, which retain them with absolute security. The armatures are wound for either 110 or 220 volts, direct current.

An important feature of this machine is the armature bearings. They are cone bearings at both ends, the cones for which have two ground surfaces, one of 3 degs. and the other of 45 degs. inclination. These cones are tightened up to any degree of tightness by the adjusting nut, T, on the shaft at the commutator end. By this means the true rigidness in running and freedom from end play, so necessary for exact grinding, are perfectly secured.

In using, the tool is mounted by the shank in the tool post of the lathe, milling machine or other machine tool, and started by inserting the extension plug, A, in the nearest incandescent lamp socket. The shank, G, is of steel and is fitted to the cap of the V-way. The V-slide permits a cross adjustment of 3 ins., by means of handle E.

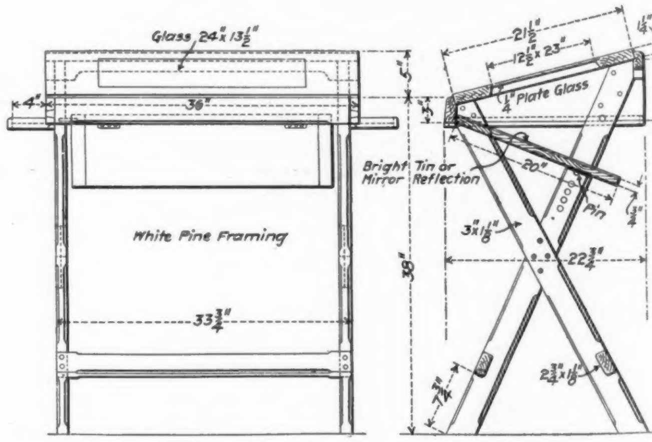
This machine has a wide range of work, such as grinding centers, cutters, reamers, dies, rolls, etc.; also surface, parallel and internal grinding jobs of all kinds. For internal grinding the extension mandrel, N, is used by removing the regular grinding wheel and attaching in its place. This permits grinding in as small a hole as the wheel on the extension mandrel will enter.

The tooth rest, F, is a valuable attachment for the grinder, serving as an index for cutter and reamer grinding, and insuring that each tooth is ground correctly by acting as a stop in rotating the cutter.

For surface grinding the device is very easily attached to the planer or shaper tool post, and used like a cutting tool. One of the best tributes to the general usefulness of this device is the use made of it in the manufacture of its own parts at the Hisey-Wolf shop. A great many of the parts are finished by grinding, but the most difficult of all, the armature core, is ground down not only for smoothness but also the necessary balancing, which is thus secured with perfect ease.

DRAWING TABLE FOR TRACING BLUE PRINTS.

During the early experience of everyone who works in a drawing room difficulties are met in tracing blue prints, especially if the prints are indistinct. Mr. W. R. Maurer, chief draftsman of the motive power department of the Buffalo, Rochester & Pittsburg Railway at Rochester, N. Y., has devised a convenient table for this purpose. The table is of pine, stained, and the complete cost is about $5. The glass is made 1½ ins. smaller than the margin of the standard size sheets



DRAWING TABLE FOR TRACING BLUE PRINTS

used on the road referred to and it is also used conveniently for one-half and one-quarter sheets. A reflector receives light from a window and projects it through the glass under the print. The reflector is hinged. By making the board separate it may be removed from the frame. The under side of the board and the inside of the frame above the reflector are painted white. In using this table it is placed in front of a window and the curtain drawn down so that the strong light comes from below. Mr. Maurer says that with this device it is possible to trace a blue print through a sheet of Whatman's paper.

GRADING OF WASTE.

TESTS DEVELOPING A SYSTEM OF "MERIT MARKING," INDICATING POSSIBILITY OF SPECIFICATIONS FOR COTTON WASTE.

The immense annual consumption of waste by large railroad systems has for a long time rendered apparent the desirability of having a system for definitely grading the various qualities of cotton waste with respect to the results that may be expected. Purchasing from the makers' classifications is indefinite, inasmuch as information is rarely given regarding the relative values of their different classes or brands.

Realizing the importance of this subject and the uncertainty of the properties defining the relative values of waste, the New York Central recently instituted an investigation of various standard commercial brands, with a view of determining data that might eventually lead to the introduction of specifications governing its purchase. The properties which are of the greatest importance in waste, namely, those of absorption, capillarity and expansion resulting from absorption, were determined for several different commercial brands. Nine samples were tested, the analyses of which appear in the accompanying Table No. 1. The absorption and the expansion resulting therefrom are given in per cent. of original volumes, while the capillarity is given both in per cent. of weight and in height, the results obtained appearing in Table No. 2, which exhibits the unexpected variations between standard brands.

An effort was made to compare the effects of the various amounts of foreign matter upon the absorption, expansion and capillarity in height, but the indications were difficult of interpretation. The general indication of this portion of the test points, however, to the fact that the waste is best which has the least foreign matter—that is, the one which is cleanest.

The most important feature of this investigation was the system of "merit marking" developed for summing up the results of the different determinations for facility in comparing total results of each brand. This consists of a numbering or ranking of the various brands tested from 1 up to the total number tested, according to their relative value or merit in each property investigated; that is, the brand having the greatest amount of foreign matter, for instance, is marked 1, the lowest rank; the brand next better is marked 2, and so on. In the same way, the brand giving the greatest absorption is given the highest rank (marked the highest number), and that giving the least is marked 1, the lowest rank. Table No. 3 shows the merit marking for the nine samples tested; brand No. 7 gave the least absorption and was therefore marked 1, while brand No. 2 gave the greatest and was thus marked 9, the highest rank of the nine tested. Where two or more samples gave equally good results in any particular property investigated, they are given the same merit mark or rank down from the highest value. The sum total of the rank numbers received in all the investigations for a sample is used as a basis for comparison of that sample with the others, giving, as it were, the total, or preponderance, of merit of that sample.

It must not be overlooked, however, that this method of comparison may not be strictly exact; this method makes the result of the investigation of each property of equal importance in its effect upon the total, whereas the investigation of one property may be of greater importance than any or all of the others. But no way is apparent for grading the importance of the results of the various properties tested, so it is probable that the method outlined above is approximately correct. It is interesting to note, however, in this connection that in Table 3 the final totals, which establish the actual relative merit of the samples tested, have graded the samples in very nearly the same order as that indicated in the column headed "Total Foreign Matter," thus adding further proof to the statement above to the effect that the less "foreign matter" there is in waste the higher its value.

The information resulting from the tests recorded in Table No. 1 is also important. It shows in one case over 14 per cent. of moisture, oils and fats; in two cases it shows 19 per cent. of dirt and coloring matter, and in another case 31 per cent. of foreign matter. It is of interest also to note that the waste which apparently shows the best in the tests contains the least amount of wool.

Specifications for cotton waste might be drawn up on a basis of the information given in Table No. 1, giving the per cent. of moisture, oils and fats allowed, the per cent. of dirt and coloring matter allowed, and the total per cent. of both, and also the per cent. of wool. The per cent. of coloring matter and dirt and of wool should be less for white waste than for colored waste.

TABLE NO. 1.

Results of Chemical Analyses of Samples of Waste.

No. of Sample.	Moisture Oils and Fats.	Dirt and Coloring Matter.	Total Foreign Matter.	Cotton.	Wool.
1	7.20%	4.30%	11.50%	66.10%	22.40%
2	3.40%	4.60%	8.00%	80.57%	11.43%
3	6.10%	19.00%	25.10%	51.83%	23.07%
4	5.10%	12.70%	17.80%	65.36%	16.84%
5	11.50%	19.50%	31.00%	52.00%	17.00%
6	14.60%	7.10%	21.70%	54.05%	24.25%
7	......	......	......	......	......
8	10.20%	14.30%	24.50%	57.27%	18.23%
9	12.80%	9.30%	22.10%	59.62%	18.82%

TABLE NO. 2.

Tests of Waste for Absorption, Expansion and Capillarity.

No. of Sample.	Absorption, Per Cent. of Volume.	Expansion, Per Cent. of Volume.	Capillarity. Per Cent. by Weight.	Capillarity, by Height — Increase in Inches.
1	424.%	7.80%	215.%	⅜" to 2"
2	489.%	9.17%	270.%	⅜" to 2"
3	352.%	7.80%	165.%	¾" to 1½"
4	441.%	9.17%	170.%	⅝" to 1⅞"
5	434.%	6.25%	110.%	½" to 1"
6	409.%	9.17%	155.%	½" to 2¼"
7	350.%	6.25%	220.%	5-16" to 1¾"
8	470.%	7.80%	125.%	½" to 1½"
9	402.%	7.80%	160.%	½" to 1¾"

TABLE NO. 3.

System of "Merit Marking" for Grading Waste.

No. of Sample.	Total Foreign Matter.	Absorption.	Expansion.	Capillarity. By Weight.	Capillarity. By Height. Solid.	Capillarity. By Height. In Strands.	Totals, giving Preponderance of Merit.
	Relative Values.						
1	8	5	8	7	7	9	44
2	9	9	9	9	7	9	52
3	3	2	8	5	7	6	31
4	7	7	9	6	9	8	46
5	2	6	7	1	8	5	29
6	6	4	9	3	8	9	39
7	..	1	7	8	6	7	..
8	4	8	8	2	8	6	36
9	5	3	8	4	8	7	35

The University of Michigan has under construction at present a much needed new building for its engineering departments. It will be very complete in its appointments, costing about $140,000, and will have a naval testing tank, a compressed-air laboratory, a hydraulic laboratory, refrigerating and cold storage apparatus and other valuable equipment.

A Lighthouse in a Desert.—There is at least one lighthouse in the world that is not recorded on any mariner's chart. It is away out on the Arizona desert, and marks the spot where a well supplies pure, fresh water to travelers. It is the only place where water may be had for forty-five miles to the eastward and for at least thirty miles in any other direction. The "house" consists of a tall cottonwood pole, to the top of which a lantern is hoisted every night. The light can be seen for miles across the plain in every direction.

DEVICE FOR SPACING DUNBAR PACKING RINGS.

The accompanying drawing represents an improved device for spacing Dunbar or similar packing rings. This device is not essentially different from the one devised by Mr. George Wales, of the West Burlington shops of the Chicago, Burlington & Quincy Railway, which was described on page 89 of our March, 1902, issue. It consists of a circular cast-iron plate, 22 ins. in diameter, with circles scribed upon its face to correspond with various sizes of pistons, the range being from 12 to 22 ins. in diameter. At the center of the plate is pivoted a forked bearing, which supports a rod extending to the edge of the plate; thus the rod may be raised and swung around

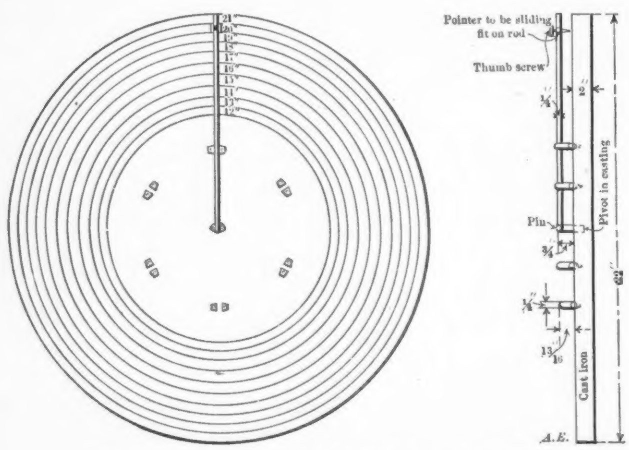


PLATE FOR LAYING OUT DUNBAR PACKING RINGS.

to any position, clips being arranged to firmly hold it at 60-degree points around the circle. An adjustable sliding pointer is arranged on the rod so that it may be clamped in any position thereupon. When the bar is dropped into one of the clips it is in position for making one of the marks on the ring to be cut; then by dropping it into all the rest of the slots and making marks by the sliding pointer, the six equidistant marks necessary for this kind of packing may be made. This has proved a very rapid combination and has many advantages for quick work. We are indebted to Mr. H. F. Killeen, of Davenport, Iowa, for this information.

The vessels which have at present the record for the most economical machinery are the steamers *Inchdune* and *Inchmarlo*, whose machinery, like that of the *Iona*, was built by the Central Marine Engine Company, of West Hartlepool. The engines are not of great size, the aggregate indicated horse-power being only 1,600. The steam pressure carried is 267 lbs. There are five cylinders, two being low pressure, but the expansion is in four stages. The cylinder diameters are 17, 24, 34 and 42 ins., the stroke of all pistons being 42 ins. The coal per horse-power on the trial trip from Hartlepool to Dover was the unprecedentedly small amount of 0.97 lb. In this machinery everything which would contribute to economy has been adopted. The steam is superheated to a temperature of about 500 deg. F., and all the cylinders, except the high pressure, are jacketed, both on the barrel and on the ends. The feed water is heated to a temperature of about 370 deg., and a light artificial draft of the induced type is used, while the boilers are fitted with Serve tubes. The economy attained in this machinery of getting a horse-power for about one pound of coal is certainly remarkable, and it makes a record which it will be difficult for other designers to excel, if, indeed, in vessels of large power, it can be reached.—W. M. McFarland, in *Engineering Magazine.*

PLANER AND MATCHER FOR THICK STOCK.

S. A. Woods Machine Company.

A special demand has developed for a heavy planer and matcher to fill the gap between the ordinary fast feed matcher and a large timber sizer. Such a machine of modern construction has been needed to perfectly dress and match thick flooring timbers, boards and other material used in car building. The S. A. Woods Machine Company of South Boston, Mass., have applied their long experience and knowledge of the requirements of car builders to the problem and have produced what is known as the "Woods No. 10, Extra Heavy Planer and Matcher" as their latest attainment.

The last few years have brought many changes in the construction of planing machines, which have helped to greatly increase the capacity and quality of the work. The principle, however, is not changed and remains the same as it has been since the introduction of the cutter-head, but the operation of the machines has been improved as stated. One of the greatest improvements is the application of the wedge platen used in this machine, as described below. This is a feature patented and controlled by these builders and is deserving of wide attention.

The adjustable wedge platen permits of changing the cut or distributing it between the top and bottom cutter-heads without either disturbing the top rolls or altering the finished thickness of the lumber. This feature also allows of instantly adjusting the machine for surfacing on one side only and with it scant sawed lumber may be made full dressed thickness. The adjustment is made from the feeding in end, from which point the moveable parts may be instantly locked in place after they are adjusted. The device resembles the table of a buzz planer, adjustable on inclines. The platen plate under the top cutter-head rests on an inclined bed which may be raised or lowered simultaneously with the lower feeding in rolls, thus increasing or diminishing the cut of either head, as desired.

Knife setting gauges which are adjustable to give the desired projection of the knife over the lip of the cutter head, permit the accurate setting of knives without measurements or the use of other instruments. Binding levers take the place of wrenches for locking the adjustable parts of the machine. The feed is arranged so that it may be operated from either end of the machine. Three distinct styles of feed can be furnished with this machine as preferred: That shown in the engraving on page 119, a friction cone feed, or a tight and loose pulley feed. The power hoist facilitates the adjustment of the top rolls and cutter-head simultaneously, or the feeding-in rolls independently. The top cutter-head may be disconnected from the regular hoisting mechanism and the rolls adjusted independently.

The bottom cutter head and its yoke are arranged to draw out by a screw, facilitating access to the knives. The system of applying pressure to the top feed rolls from below obviates overhead weights. The pressure bar or platen over the bottom cutter head acts as a gauge for thickness of the finished stock and may be adjusted in a parallel plane, or either end may be disconnected from the hoisting mechanism and raised or lowered independently, all from the operating side.

Both the top and bottom cutter heads are double belted, the upper feeding in rolls are solid, although sectional rolls and expansion center guides may be applied if desired. There are six feed rolls, 9½ ins. in diameter. The side chip breakers are sectional with shoes independently adjustable. The expansion gearing is properly covered and ample provision is made for taking away all shavings, etc.

The machine is built to work 18 to 30 ins. wide up to 12 ins. thick. Its special features are covered by patents.

BOOKS AND PAMPHLETS.

Ancient and Modern Engineering and the Isthmian Canal. By Wm. H. Burr, Professor of Civil Engineering, Columbia University. 8vo, 473 pages; profusely illustrated. 1902: John Wiley & Sons, 43 East Nineteenth street, New York. Price, $3.50; postage, 27 cents additional.

The basis of this book is a series of six lectures delivered by Professor Burr in 1902 under the auspices of Columbia University. The lectures have been somewhat elaborated for this publication. The first part, on ancient civil engineering works, contains much of interest and covering considerable range, most of it not readily available in engineering literature. The second part, on bridges, touches the subject somewhat technically as well as historically and is well up to date in methods of treatment and in the features covered. The same is true of part three, on waterworks, which is treated from many standpoints, some of which are too new to have received complete and up-to-date attention in most text-books. Filtration, in particular, and also purification, waste and storage, receive intelligent attention. The railroad part, after touching upon the general subject interestingly, looks more particularly into signalling and the development of the locomotive. Parts five and six have to do with the Nicaragua and the Panama routes for a ship canal, which Professor Burr can treat somewhat authoritatively, being a member of the canal commission. Of course, this matter is both new and interesting. It is not altogether usual to find so much of solid good and so little that fails to prove of value, especially in a book with such an origin as stated above. The book is finely printed and is full of half-tone and other illustrations. Altogether it is both an attractive and a valuable book for any engineer's library.

The Sea Coast. (1) Destruction, (2) Littoral Drift, (3) Protection. By W. H. Wheeler, M. Inst. C. E. Illustrated. Longmans, Green & Co., 91 Fifth Avenue, New York. 1902. Price $4.50.

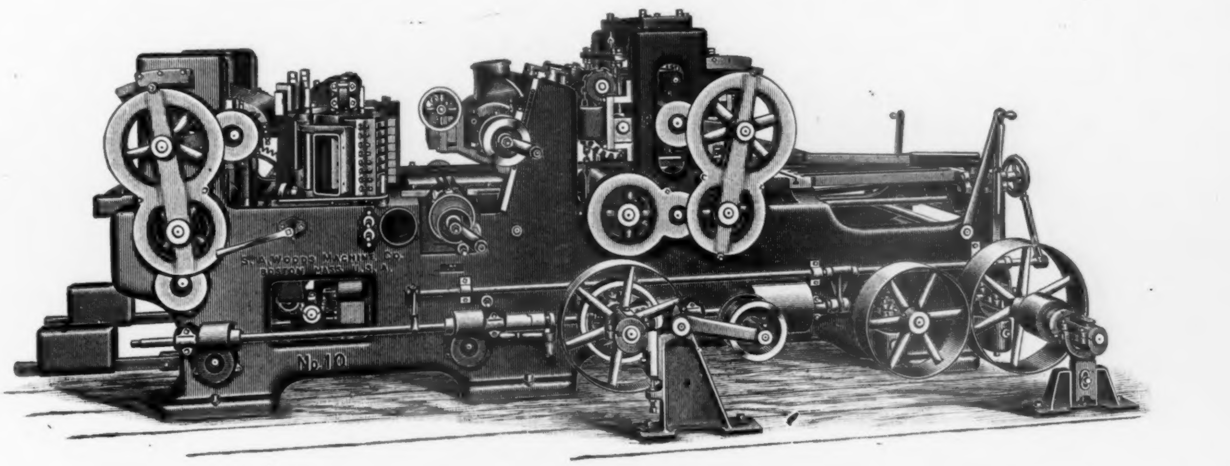
The purpose of the writer of this book is to present clearly the conditions of the sea coast which arise from the varying agencies of change and degrees of exposure. After a brief general consideration of the sea coast and of the destructive action of shore waves, the author gives a more extended treatment of the littoral drift. In portraying this important part of the action of the sea the author describes notable examples which represent the diverse effects in various countries. One chapter is devoted to a general description of sea walls. In another chapter examples of sea walls are described and their construction illustrated. Another chapter treats upon groynes, their construction, use and advantages. The coast of England has an important history and is an interesting study which merits the descriptions which Mr. Wheeler gives of it at various points. His final chapter is upon the coasts of the north of France, of Belgium and of Holland. The author clearly describes the conditions of the coasts, and his conscientious care and accuracy enhance the value of the volume. He appreciates the importance of a knowledge of the physical conditions to the engineer who seeks either to evade or to resist the destructive power of the sea by the structures which he designs.

The Steam Turbine. By E. H. Sniffin. The paper upon this subject by this author, read before the American Street Railway Association at the recent Detroit meeting, has been reprinted in pamphlet form by Westinghouse, Church, Kerr & Co., and copies may be obtained from any office of that company.

"Leading Newspapers" is the title of a convenient little book of 200 pages published by Geo. P. Rowell & Co., 10 Spruce street, New York, in which the leading papers are discussed from the standpoint of the advertiser. The bulk of the space is occupied by a list of leading papers, including newspapers and journals devoted to special classes of readers. The list states the circulation of each in case the publishers are willing to disclose the figures for the purpose. It is a valuable little book which will be very convenient for reference by the advertiser. Its price is $1.

The Joseph Dixon Crucible Company have distributed a souvenir pamphlet of the inspection trip of the American Society of Civil Engineers to the new terminal of the North German Lloyd Steamship Company at Hoboken on the occasion of the fiftieth annual meeting of that society, held in New York in January. The pamphlet presents construction views of this fireproof terminal, and notes the fact that the entire structural steelwork of the buildings and piers is protected with Dixon's silicon graphite paint. The pamphlet presents an excellent idea of the construction of this interesting group of structures. It is well worth sending for.

The American Blower Company, Detroit, Mich., have issued two new pamphlets. The first illustrates the application of their heating and ventilating system to a number of large manufacturing plants and railroad shops. The illustrations present typical large plants, and the text gives the reasons for the adaptability of the fan system of heating to them and the reasons why it is the only economical and satisfactory method of heating large buildings. The pamphlet gives an excellent general idea of the "A. B. C." system. The other pamphlet is devoted to the "A. B. C." moist air dry kiln patented by this company. This little pamphlet is intended to give enough information to lead to requests for the larger catalogue, No. 139, which may be had upon application.



PLANER AND MATCHER FOR THICK STOCK.

S. A. WOODS MACHINE COMPANY.

(FOR DESCRIPTION, SEE PAGE 118.)

Frogs, switches, switch-stands, rail-braces and similar equipment manufactured by the Weir Frog Company, of Cincinnati, Ohio, are illustrated and described in "Catalogue No. 6," just issued by them. This is a popular and convenient catalogue. Its purpose is to present by numbered engravings the varieties of work this firm is prepared to furnish, and those desiring this material will do well to read the concise statements made in connection with these illustrations, and apply for further information if necessary. The chances are that orders may be based upon the catalogue, so great is the variety of work shown. At the end of the book is a valuable collection of twenty-two tables containing information concerning track and track work. Railroad officers and others who have anything to do with track work should procure a copy of this catalogue.

The Counsellor.—A unique and interesting publication bearing this title has come from the office of Clarence P. Day, 140 Nassau street, New York. It is devoted to the interests of mechanical trade and class advertisers, advertisement writers and publishers. It stands for scientific treatment of the problem of publicity, and its pages are full of suggestions, both in the form of text and illustration. The underlying idea presented is that advertising to be effective must be directed by specialists. Mr. Day is well qualified by ability and experience to advise and conduct active campaigns in this service, and his "advertising shop," from which this interesting publication comes, is evidently well equipped in all particulars for effective work. The Counsellor will appear as a quarterly, and probably later as a monthly, publication. It is a fine piece of printing, the color work on the covers being especially pleasing and effective.

The Jeffrey Manufacturing Company, Columbus, Ohio, have issued a pamphlet describing the Barney brick-conveyor system. In a number of well-selected engravings the application of this simple system of conveyors to the service of brickyards is shown. These conveyors are built for capacities varying from 5,000 to 35,000 bricks per hour, either loaded on cars or piled in storage. Those who have had to do with handling bricks by the hand-labor and wheelbarrow method will at once appreciate the advantage of this system, which not only cheapens the handling but greatly increases storage capacity. The essentials of this system are an endless carrier chain, a series of swinging baskets, and an overhead track or runway. The pamphlet also describes other well-known specialties of this company in conveyors and allied machinery.

INDUSTRIAL NOTES.

The Railway Appliances Company and the Q. and C. Company announce that they have consolidated interests and that the business of both concerns will be continued under the name of the Railway Appliances Company, Old Colony Building, Chicago, with the following officers: Mr. H. K. Gilbert, president; Mr. C. F. Quincy, vice-president; Mr. G. H. Sargent, manager, and Mr. Percival Manchester, secretary.

A large installation of Nernst lamps is to be made in the Farmer's National Bank building in Pittsburg, which is to be the largest business building in that city. The Westinghouse Electric and Manufacturing Company have furnished three 150 kw. and one 75 kw. alternating current generators and the entire building will be lighted with Nernst lamps, as follows: One thousand 55-watt single-glower, 1,250 88-watt single-glower, 20 two-glower and 20 six-glower lamps. This is a high tribute to this lamp.

The Chicago Pneumatic Tool Company has issued through President Duntley a financial statement for the year ending December 31, 1902, showing its financial condition to be very strong and its business to be most satisfactory and gratifying. In order to concentrate manufacture and improve the facilities for meeting the increased demands of purchasers, the Aurora factory is to be consolidated with the Cleveland plant. This will greatly increase the output. In his address to the stockholders President Duntley states that the business for January, 1903, was 50 per cent. greater than that of the same month in 1902.

The O. M. Edwards Company, of Syracuse, N. Y., inform us of a change in their office in Chicago. Mr. B. S. McClellan has been appointed Western manager, to succeed Mr. E. E. Silk, who has resigned. Mr. McClellan has charge of the Western territory and the office in the Fisher building, Chicago.

The Philadelphia Bourse is evidently appreciated as an effective factor in bringing manufacturers of machinery and products before purchasers through the exhibition department. The present year opens with a number of new exhibitors and enlarged spaces have been taken by others who have been using these excellent facilities. Applications should be made to Mr. W. H. Rogers, superintendent The Bourse, Philadelphia, Pa.

The Holland Company, with main offices in the Great Northern Building, Chicago, have opened an office in San Francisco, 508 Market street, with Mr. F. F. Small as Pacific Coast manager. Previous to his connection with the Holland Company Mr. Small was for many years draughtsman of the Southern Pacific Company, and recently engineer of tests on the Mexican Central. The Holland Company, besides handling their own patented specialties, are also Pacific Coast representatives of the H. W. Johns-Manville Company's products; also those of the Dake Engine Company, and sole agents for the Marion Malleable Iron Works on the Pacific Coast.

A prospectus of the Magnolia Metal Company offering $200,000 of 7 per cent. preferred stock has been received. This issue is for the purpose of increasing the working capital and for business extension due to the large expansion of business. In addition to the manufacture of Magnolia Metal and Defender, Mystic and Kosmic this company now produce every grade of babbitt, linotype, stereotype and other similar metals. The steady growth of the business of the company has been noted and the plan of increasing its capital will undoubtedly add an important advantage. Subscriptions may be sent direct to the Magnolia Metal Company, 511 West Thirteenth street, New York City.

The New York Central & Hudson River Railroad has recently placed an order with Westinghouse, Church, Kerr & Co. for four Westinghouse-Corliss engines of the horizontal cross-compound type. These engines will form the main power equipment of a new power station in process of erection on the company's property at Weehawken, N. J., which will supply power to the grain elevators and shops there located. Two of the engines are of 1,200-h.p. normal capacity and the remaining two of 700 h.p., each pair being direct-connected respectively to 750 and 400-kw. polyphase generators of the revolving field type. They will operate with 140 lbs. of steam superheated to 500 degs. F., and with high vacuum. The equipment also includes a small exciter engine of the Westinghouse vertical compound type.

The steam turbine equipment of the Hartford Electric Light Company, Hartford, Conn., is to be duplicated in the near future by machines manufactured by the builders of the original installation, the Westinghouse Machine Company, Pittsburg, Pa. The present Corliss engine equipment will be replaced by two 1,000-h.p. turbines, direct-connected to revolving field polyphase generators. These units will operate in parallel with the 1,300-kw. unit installed one year ago and were chosen for the purpose of securing the utmost flexibility and economy in the operation of the plant. The turbine plant will operate with superheated steam, with 150 lbs. pressure and a high vacuum. The original installation created much interest among engineers and power users, and it is a gratifying reflection that the first American steam turbine of large size has given such immediate satisfaction as to warrant an extension of the turbine equipment and the relegation of the steam engine, after one year's operation. Although the Westinghouse-Parsons steam turbine has been on the market less than four years, 4,000 kw. of turbine machinery have been put into service and 75,000 kw. have been contracted for. The Westinghouse Machine Company find it necessary to build a new turbine shop to meet increasing demands. This turbine is controlled by Westinghouse, Church, Kerr & Co., New York.